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# THE CHERNOBYL DISASTER: IMPLICATIONS FOR WORLD FOOD SECURITY AND THE U.S. FARM ECONOMY

## HEARING

BEFORE THE

SUBCOMMITTEE ON
AGRICULTURE AND TRANSPORTATION

OF THE

## JOINT ECONOMIC COMMITTEE
## CONGRESS OF THE UNITED STATES

NINETY-NINTH CONGRESS

SECOND SESSION

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MAY 5, 1986

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# THE CHERNOBYL DISASTER: IMPLICATIONS FOR WORLD FOOD SECURITY AND THE U.S. FARM ECONOMY

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MONDAY, MAY 5, 1986

CONGRESS OF THE UNITED STATES,
SUBCOMMITTEE ON AGRICULTURE AND TRANSPORTATION
OF THE JOINT ECONOMIC COMMITTEE,
*Washington, DC.*

The subcommittee met, pursuant to notice, at 2:10 p.m., in room SD-124, Dirksen Senate Office Building, Hon. James Abdnor (chairman of the subcommittee) presiding.

Present: Senators Abdnor and Mattingly.

Also present: Robert J. Tosterud, deputy director; and John Starrels, professional staff member.

## OPENING STATEMENT OF SENATOR ABDNOR, CHAIRMAN

Senator ABDNOR. The Subcommittee on Agriculture and Transportation of the Joint Economic Committee will be in order.

I know we have a great deal of interest today in our subject matter. I know that many are asking the questions that remain in the aftermath of the disaster at Chernobyl, and they will not be answered for decades, I am sure.

But today's hearing will try to address just one remnant of Chernobyl, the short- and the long-term implications for this nuclear accident on agriculture and world food security.

Now, it is this kind of event that places our food surpluses in a different light. At the rate of consumption of 4.4 million metric tons per day, the world cereal stocks would vanish in less than 2 months. One-half of those stocks are here in the United States.

Chernobyl has reminded us how vulnerable the food system in this country is. The world has the need and the right to know the health consequences of consuming food produced in regions of the Soviet Union, Europe, and Scandinavia impacted by this nuclear accident.

These regions produce substantial quantities of beef, pork, cereal, beverages, and dairy products for export, a significant amount of which find their way into the U.S. markets.

The Chernobyl incident has also had its impact on the U.S. commodity markets; first tremendously bullish, then very bearish—remarkable. Some commodity prices may well settle lower than levels prior to Chernobyl.

Futures markets continue to bewilder me, and I think 9 out of 10 farmers and ranchers also are befuddled, I might add.

Again, this hearing can do nothing to provide the kind of concrete answers that will affect markets, but I am sincerely hopeful that the testimony today is calming and convincing and that this tragic episode is behind us and, equally important, that we have all learned some lessons.

The Chernobyl disaster was apparently the failure of one of four reactors at one powerplant. Maybe somebody is trying to tell us something, and maybe we had better listen.

On behalf of the Joint Economic Committee, I thank and welcome our distinguished guests who, under severe time pressures, have thoughtfully responded to our urgent invitation to appear before us today, and I say that very sincerely. I know the short time you had to prepare to be here with us, and we are very grateful for your efforts in doing so.

I just want to say at the outset that Mr. Machta is unable to appear this afternoon.

The National Oceanic and Atmospheric Administration has informed us that exceptional high and fast winds have blown the nuclear plume containing radiation into the U.S. territory, and Mr. Machta is at this moment monitoring this development. Frankly, I would rather have him there than here at the moment.

However, we do have an outstanding group of witnesses today who have agreed to appear, and our first witness is—well, first, let me just tell you who they are.

We have with us Alan Robock, who is with the Department of Meteorology at the University of Maryland; we have Prof. Miro Todorovich. Mr. Todorovich is executive director of Scientists and Engineers for Secure Energy out of New York; Mr. Frank McCormick, radiation ecologist at the University of Tennessee; Mr. John Urbanchuk of Wharton Econometrics; Mr. Donald Frahm, vice president of Sparks Commodities, Inc.; and a little later—he can't be here at this moment, but he will be soon—Mr. Dwayne Andreas, who is chairman and CEO of Archer Daniels Midland Co., Decatur, IL.

So with that excellent group of witnesses, I know this is going to be a very worthy and needed hearing.

I am going to ask Mr. Robock, Mr. Urbanchuk, and Mr. Todorovich to appear as our first group of witnesses. If you gentlemen will come forward, we anxiously await your testimony.

We are really happy you were able to fill in like you have on this short notice, and we are anxiously waiting to hear from you, Mr. Robock. You may proceed.

## STATEMENT OF ALAN ROBOCK, ASSOCIATE PROFESSOR, DEPARTMENT OF METEOROLOGY, UNIVERSITY OF MARYLAND

Mr. ROBOCK. The accident of Chernobyl released radioactive particles into the atmosphere at different heights in the atmosphere.

At low levels in the atmosphere the winds tend to be not as strong, and the particles remain closer to the source before coming out. However, when they go higher in the atmosphere, the winds are stronger and can take them much longer distances before they come out of the atmosphere.

I also checked today with NOAA and the EPA, and they said that an airplane off the west coast of the United States has measured radioactive particles in the atmosphere at jet stream levels at about 30,000 feet and above, and so there are now particles of radiation at high altitudes over the United States.

At lower altitudes it will take longer for them to arrive here because the winds are not as strong.

The greatest chance to first detect it at the ground in the United States would be if a large thunderstorm went high up into the upper atmosphere and some of the particles dissolved in the rainwater and came out at the ground.

I have been doing research on the climatic effects of nuclear war, the so-called nuclear winter, over the past couple of years, and this just further reminds of the fragility of our food chain. If there were large climatic changes, then not only the local area around Kiev but the whole world, the whole Northern Hemisphere might be subject to the same sorts of worries about sources of food.

Senator ABDNOR. Professor, thank you.

Mr. ROBOCK. I will be happy to answer any questions.

Senator ABDNOR. We will be very happy to ask you some in just a few moments, and again, Mr. Robock, we thank you for being here today.

Our next testimony will be from Mr. John Urbanchuk; you are certainly not new—this is not your first time before this committee. As a matter of fact, I think it was just last week that you were here. That is how highly we think of you and your testimony, and we are indeed grateful for your appearance here today.

**STATEMENT OF JOHN M. URBANCHUK, DIRECTOR, INTERNATIONAL AGRICULTURE, WHARTON ECONOMETRIC FORECASTING ASSOCIATES, INC., PHILADELPHIA, PA**

Mr. URBANCHUK. Well, thank you, Mr. Chairman. I am pleased to appear before the subcommittee to discuss Wharton Econometrics' views on the impact of the Chernobyl nuclear disaster on three elements—Soviet agriculture, world food supplies and world food security; and the United States farm economy.

Experts on the nuclear power industry and on effects of radioactivity and nuclear fallout, both in the United States and Europe, are concluding that the accident just over a week ago at the Soviet nuclear plant in Chernobyl in the Ukraine is the worst such accident in history.

Now, concerns over the impact of radioactive contamination of the Ukrainian grain crop and livestock inventory and over the potential impact on Soviet grain production and import demand were reflected in the three most active days the U.S. and world commodity markets have seen since the 1983 drought.

The activity in the markets was not limited to grains and oilseeds. Livestock markets in the United States reacted very, very substantially to fears over the potential contamination of meat and dairy supplies, particularly in Northern Europe and Scandinavia. Keep in mind that we import meats and dairy products from those areas. There are some concerns that this might affect the supply and that all will affect the U.S. markets.

There have been other elements, as there normally are in the markets, but that appears to be the background for the three most active days. And keep in mind the markets have been dull and uninteresting. They have been flat and declining. This incident provided the first real impetus for a substantial movement in the markets.

Based on information made public to date about the accident contamination, it is our opinion that the Chernobyl accident is unlikely to result in disaster for the current Soviet crop or for that matter have a persistent and long-lasting impact on Soviet agriculture.

We feel there are several ways that radioactive contamination can adversely impact agricultural production in the Soviet Union in the surrounding areas that have been subjected to fallout contamination.

Now, at the outset I have to admit that I am not an expert on the effects of radioactivity on crops and livestock. What I have attempted to do is to take a look at the area that has been affected, bringing together some prior information that I have on fallout effects that is gleaned from the General Staff College and other sources to try to hypothesize on what they are like.

Even experts, however, are going to find they are at somewhat of a disadvantage in analyzing the impact due to the poor quality and amount of solid information about the isotopes released, the rates of release, and contamination levels in a specific agricultural area.

Due to the paranoia inherent in the Soviet system, it is unlikely that we will ever get full information on many of these areas. So we will really be put in a position of speculation.

There are several areas that radioactivity could contaminate, and they are the existing crops, primarily maturing winter grains. It may render them unusable.

Agricultural land could be contaminated so severely that the crops couldn't be harvested or that the land couldn't be used for the planting of summer crops.

Ground and/or subsurface water supplies could be contaminated, thereby endangering crops.

Livestock herds could receive such severe contamination they would have to be liquidated. The meat may or may not be consumable.

Finally, milk supplies will be contaminated by the passthrough of radioactive isotopes by dairy cows.

Primarily I have looked at the impact on crop grain, keeping in mind that the Soviet Union is the world's largest importer of grain and that severe annual fluctuations of grain crops, in prior times due to weather, have ended up filtering through to the world markets through increased imports of grain.

One other area is fruits and vegetables and contamination to them. Again, that is a scenario that should be looked at, and I haven't really done so.

On the area of grains, the Soviet Union hasn't released any official grain production numbers on either a national or a republic basis since 1980. But this year, for the first time, they have given us an idea of what area harvest is by republic. We are using these numbers and some real guesstimates with regard to average yields.

We find that three republics—the Russian Federated Soviet Republic, which is the largest in the Soviet Union, the Ukraine and Kazakhstan—account for 93 percent of the total grain area. The Ukraine alone, which is the area that the plant is located, represents 13.5 percent of Soviet grain area.

In the prepared statement that I have given the subcommittee you will find tables that list by republic the area by selected grain for the Soviet Union and also livestock numbers, to give you a comparative idea of where the Ukraine fits in by grain and by livestock category.

The point is that in terms of total Soviet grain area the Ukraine represents roughly 13.5 to 14 percent maximum. The areas north and northwest of the plant, basically the Byelorussian Republic, Latvia, Lithuania, and Estonia, represent relative minor—or let's say less prominent—producers of grain area.

Moreover, with regard to the Ukraine, the real importance of that particular area is that it is the largest producer of winter wheat in the Soviet Union.

Now, wheat represents basically half of the total grain produced in the Soviet Union, and winter wheat is roughly a third of that. So the Ukraine is the largest producer of winter wheat in the Soviet Union.

The importance of winter wheat in this case is that the crop is seeded in the fall, remains dormant through the winter, emerges in the spring, and matures and is harvested in late spring or early summer. It is emerging and maturing now, precisely at the time when the accident occurred. Whether that makes an impact with its sensitivity to radioactivity I am not sure, but it is something to keep in mind.

As I indicated, the average yield data are not available for the Ukraine. This republic almost exclusively consists of Chernozem type soil, which is naturally fertile black earth. It is among the most productive soil in the Soviet Union. As a result, we can assume that under normal conditions grain yields in the Ukraine are higher than the Soviet average.

As I said, the Soviets haven't released official grain data. We are working on the basis of USDA Foreign Agriculture Service estimates. The USDA puts the 1985 crop at 190 million metric tons, an average yield per hectare—2.5 acres—of 1.61 metric tons.

We assume again that the Ukrainian average yield—again I don't have good numbers for this—is half again that of the Soviet Union. A loss of the full Ukrainian grain crop would reduce Soviet grain production by a maximum of about 20 percent.

Since not all the Oblasts in the republic, notably those in the southeast and the extreme southeast and the extreme southwest, would receive the same amount of contamination and since other smaller producing republics—Byelorussia, Latvia, Estonia, Lithuania, and perhaps the western Oblast of the RSFSR—would be contaminated as well, we assume that the potential maximum loss to the new Soviet crop would be about 10 percent. If we use current USDA estimates of the 1985 crop at 190 million metric tons, this would represent a loss of somewhere between 19 and 20 million metric tons for a total crop of about 170 million metric tons.

Also, 170 million metric tons would make this crop the third smallest in 12 years. When you look at the variation in the Soviet harvest over the past 25 years and find that severe variations in average yields do take place, this action is not likely to result in a crop that would fall outside the range of normal variation.

This does not mean that the Soviets would not have a bad crop. It would, in fact, be a bad crop. But I suspect it would be a disastrous crop for the Soviet Union.

There is another area that we have to consider—the danger just to the new crop for the 1986 grain harvest. This could be affected over a longer term by a total loss of area due to extreme contamination, and that is the area perhaps most closely surrounding the plant location, some radius affecting the Kiev Oblast, that would essentially take that area out of production for some extended period of time.

I have no way of assessing the likelihood of that or, for that matter, essentially how much is produced within that specific Oblast. I do not, however, expect that this would be a serious problem to future crops.

Now, on the livestock and meat area, the Ukraine does have the second largest livestock inventories in the Soviet Union and it accounts for a significant amount of the total milk production. Radioactivity contaminates milk production in virtually all exposed areas. Radioactive isotopes pass through the milk cow very directly into the milk supply. [Laughter.]

Senator ABDNOR. Please, let's have order here so we can hear our witness.

Mr. URBANCHUK. The severity of the contamination will determine whether the livestock herds have to be liquidated; the key to keep in mind here is that if, in fact, livestock herds are liquidated that may or may not result in increased meat supplies on the Soviet market. But what it will mean is that smaller animal numbers will translate into a change or lowering of the feed demand base next year and perhaps the year after that.

So that is an element to look at, too, with regard to the total Soviet grain demands.

Severe contamination of milk production will likely force the Soviets to import dairy products, primarily dried milk and other dairy products such as cheeses and butter, most likely from the European Community.

Traditionally, the Soviets have also increased imports of vegetable oils, and the most prominent one being soybean oil, to augment a shortfall in animal fat production and butter production. Now, if this were the case the United States would likely benefit from increased Soviet imports of vegetable oil. We are the leading producer of soybean oil.

Again, I doubt seriously whether this can be viewed as a disaster for the Soviet agricultural system—based on the information that we have on hand and from a layman's perspective.

Turning to the impact on world food security, as you yourself, Mr. Chairman, pointed out, we are in a precarious position with regard to world food supplies in the sense that they fluctuate. However, we find that the world is currently faced with record stocks of wheat and coarse grains.

According the USDA Foreign Agricultural Service data and estimates, global wheat supplies at the end of the current marketing year will total a record 127.7 million metric tons.

Now, one of the measures that economists look at in order to judge how large that really is, is the stock demand ratio, which says how much of demand can be fulfilled with the current stock. For wheat that is 27 percent. That is the largest stock demand ratio in the past decade. This oversupply, which, in fact, is largely accounted for by increases among importers, has been a major factor behind the decline in the total level of world wheat trade that we have seen over the past year or so.

Similarly, world coarse grain stocks are projected to reach a record 162 million tons, with the stock demand ratio at about 21 percent. That is the highest level in almost two decades.

So from a historical perspective, the world grain situation can withstand a shortfall of let's say 10 percent of the Soviet grain crop without putting undue pressure on prices or on the availability of grain for other importers.

I believe the world situation with regard to grains can take that now.

On the dairy and meat side, supplies of dairy products, particularly in the EC intervention stockpiles, are more than large enough to meet any increased import demand from either the U.S.S.R. or other countries that have been affected by the accident. These stockpiles also help offset any losses experienced by EC members, particularly those in Scandinavia or other European countries. And in fact, the drawdown of these stocks may actually strengthen the EC's common agricultural policies by reducing stocks and reducing the expense of maintaining those very, very high, inventory levels.

So the impact on the world doesn't appear to be that substantial.

Now if we turn to the U.S. agriculture sector, actually we end up as potential net beneficiaries of this situation. Some or all of the Soviets' increased demand for grain and soybean oil, as a result of the disaster, is likely to come from the United States. Since the major impact is likely to be on Ukranian wheat, the Soviets may be forced to import wheat. Now if they import wheat, most of it is likely to come from non-U.S. sources, primarily because the Soviets are not eligible for the price incentives that are a part of the USDA's export enhancement program, BICEP. Essentially that means they pay a premium for our wheat, and given that there is a lot of wheat in the world market, particularly among our competitors, it doesn't make sense for them to buy from us and they have turned to other suppliers.

If the Soviets do import wheat, the ones who will benefit the most are the European Community, Canada, and probably Australia.

I expect that the United States is likely to benefit from increased wheat exports to the Soviet Union. We are currently expecting the U.S.S.R. to buy 4.4 million metric tons, roughly 160 million bushels of wheat, during the 1986–87 session. Keep in mind that we do have a long-term grain trade agreement with the Soviets, and while they haven't lived up to the letter of the law in the recent years, it is still there, and there is a possibility to meet that. A shortfall of 10 percent in the Soviet harvest may result in as much

as an additional 20 million tons of total grain imported. Well, the majority of that is likely to be wheat. If the Soviets increased imports of wheat from the United States by an additional 2 million metric tons, 78 million bushels next session, we estimate the U.S. farm price of wheat would increase 14 cents a bushel to $2.64 for the 1986-87 session.

Now again in the testimony that I gave you, we did some simulations over the weekend with our U.S. agricultural sector model to determine what the impact of increased export demand would be on wheat, corn, soybeans net farm income. Those supply and demand tables, net farm income tables, are appended to my prepared statement. You can take a look at those at your leisure. I am not going to worry you with reading all the numbers that are there.

The point is that increased Soviet imports from the United States would benefit U.S. wheat prices and U.S. corn prices. Now we would expect that since the United States is the predominant exporter of corn in the world and the Soviets do buy a substantial amount of corn—they are a corn-deficient country—that we would likely experience the bulk of increased Soviet imports. We are assuming again an additional 5 million metric tons or 197 million bushels of increased Soviet imports in 1986-87 are likely to add 35 cents to a bushel of corn in 1986-87. An increased level of exports over the next several years will similarly raise prices over that period of time.

Now keep in mind that with the new farm bill, we have prices that are down at or just below the loan level for the next several years. I might also add that with the conservation reserve program that's taking land out of production, in addition to the set-aside program, basically, we're restraining growth and output. At the same time, increases and exports that would come about through increased Soviet purchases would have a constructive impact on prices.

Now those higher prices plus increased demand activity will directly translate into higher cash receipts and net farm income for the American farmer.

Based on the increased prices and increased export activity, we feel that increased Soviet purchases as a result of the Chernobyl accident—now these are maximum—would add somewhere in the area of about $6 billion to net farm income over the next 4 years. So essentially, we are looking for about a $1.5-$1.6 billion addition in net farm income as a result of increased prices and increased demand over the next 4 years.

What that does, essentially, is take some of the burden off the Government to support the American farmer, particularly in the next 3 or 4 years. Plus higher prices will reduce that amount of direct Government payments to the farmers, part of the Farm Belt, and return more of that to the market. And really, the whole point of the 1984 Security Act is to move American agriculture away from a fully supported point to a more market-oriented point. This may not be the most socially desirable way to get there, but I think that we will find that increased Soviet imports are likely to be beneficial to the American agricultural sector.

Now to conclude, the Chernobyl nuclear accident is clearly a disaster for the Soviet Union. Moreover, it is a disaster for everyone in the world, particularly those who are looking at nuclear energy as a power source for the future. It is unlikely, in our opinion, to result in a larger decline in Soviet grain production than might be expected by recurring adverse weather conditions.

The Soviets may find it necessary to increase imports of grain, dairy products, and possibly meat. In the case of increased dairy and meat imports, the most likely beneficiaries will be the EC and possibly East Europe, Poland, and Hungary—Hungary in particular. The Soviets will likely continue to increase wheat imports from non-U.S. sources but rely on the United States for additional coarse grains. Thank you very much, Mr. Chairman.

[The prepared statement of Mr. Urbanchuk follows:]

PREPARED STATEMENT OF JOHN M. URBANCHUK

**Summary and Introduction**

Mr. Chairman, I am pleased to appear before this Committee to discuss the views of Wharton Econometrics on the impacts of the Chernobyl nuclear disaster on Soviet agriculture, world food supplies, and the U.S. farm economy.

Experts on the nuclear power industry and effects of radioactivity and nuclear fallout, both in the United States and in Europe, are concluding that the accident just over a week ago at the Soviet nuclear power plant at Chernobyl in the Ukraine is the worst such accident in history.

Soviet authorities have been slow to release details of the full extent of the accident and the resultant radioactive contamination of the population, land, and water supply in the Ukraine and neighboring Byelorussia, or the potential for contamination of other countries in Europe. Nevertheless it appears that a malfunction in the plant may have resulted in a core meltdown, chemical explosion which destroyed part of the plant, a fire centered in the nuclear fuel rods, and a substantial release of radioactivity that has been detected in Scandanavia and Central Europe.

Concerns over the impact of radioactive contamination of the Ukrainian grain crop and livestock inventory, and potential impact on total Soviet crop production and import demand were reflected in the three most active days the U.S. and world commodity markets have experienced since the drought of 1983. The activity was not limited to grains and oilseeds as livestock markets reacted to the fear that contamination of meat and dairy products in Poland and Scandanavia would reduce U.S. imports of processed meat and cheeses from those countries.

Based on information made public to date about the accident and contamination, it is our opinion that the Chernobyl accident is unlikely to result in a disaster for the current Soviet crop, or have a persistent or long lasting impact on Soviet agriculture.

Moreover, given the current record global surpluses of wheat and coarse grains, the accident is also unlikely to provide a threat to world food security. It does seem likely, however, that the Soviets may increase imports of grain, vegetable oils, dairy products, and meat over at least the next year. These stepped up imports will be welcomed by the world grain markets and should benefit the European Community, Canada, Argentina, and the United States.

This paper will attempt to analyze the impact of the Chernobyl disaster on Soviet agriculture, the world grain situation, and the U.S. agricultural sector.

**Impact of Chernobyl on Soviet Agriculture**

There are several ways that radioactive contamination could adversely impact agricultural production in the Soviet Union and surrounding areas subjected to fallout from the Chernobyl disaster.

- Radioactivity may contaminate the existing crops, primarily maturing winter grains, rendering them unusable.
- Agricultural land could be contaminated so severely that crops could not be harvested, or prepared for planting summer crops.
- Ground and/or subsurface water supplies could be contaminated thereby endangering crops.
- Livestock herds could receive such severe contamination that they would have to be liquidated. The meat may or may not be consumable.
- Milk supplies will be contaminated by the pass through of radioactive isotopes by dairy cows.

At the outset it must be admitted that I am not an expert on the effects of radioactive contamination on crops or livestock. Further, even experts in these fields are at a disadvantage in analyzing the impact due to the paucity of solid information about the isotopes released, rates of release, and contamination levels in specific agricultural areas. Due to the paranoia endemic to the Soviet system, it is questionable whether this information will ever become officially available.

Based on published information and statements of U.S. and European governments, it appears that the most substantial aerial contamination was concentrated in the immediate vicinity of Pripyat where the Chernobyl reactor is located, and areas to the north and northwest. Apparently some contamination of the reservoir that supplies Kiyev and the Dnepr River has taken place. If this is the case, then in addition to Kiyev Oblast where the plant in located, at least half of the Ukraine, and virtually all of Byelorussia, would have received considerable radioactive contamination. Additionally, Lithuania, Latvia, and Estonia, as well as the western Oblasts of the RSFSR, may have been exposed.

**Grains**

While the Soviet Union has not released grain production figures on either a national or republic basis since 1980, official Soviet statistics indicate that three republics -- the RSFSR, Ukraine, and Kazakhstan -- accounted for about 93% of total grain area in 1985. Area harvested in the Ukraine represented 13.5% of total Soviet grain area. A breakout of grain area by republic for 1985 is displayed in Table 1.

Table 1

Soviet Union: Area for Selected Grain by Republic - 1985
(Million Hectares)

| | RSFSR | UKRAINE | KAZAKHSTAN | OTHERS | TOTAL |
|---|---|---|---|---|---|
| Winter Wheat | 8.4 | 6.7 | 1.0 | 2.0 | 18.1 |
| Spring Wheat | 16.9 | ** | 15.2 | 0.2 | 32.3 |
| Barley | 16.1 | 3.1 | 6.8 | 2.9 | 28.9 |
| Oats | 11.0 | 0.6 | 0.4 | 0.6 | 12.6 |
| Rye | 7.3 | 0.7 | 0.2 | 1.4 | 9.6 |
| Corn | 1.1 | 2.6 | 0.1 | 0.7 | 4.5 |
| Other | 7.3 | 2.2 | 1.3 | 0.8 | 11.6 |
| TOTAL | 68.1 | 15.9 | 25.0 | 8.6 | 117.6 |

Source: USDA/FAS

The predominant grain crop in the Ukraine is winter wheat, accounting for about 42% of harvested area, further the Ukraine accounts for 37% of total Soviet winter wheat area. The two other leading grains produced in the Ukraine are barley and corn, which as feedgrains, are used primarily for livestock feeding.

The significance of winter wheat is that this crop is planted in the fall, remains dormant during the winter, emerges in the spring, and is harvested in early summer. The Chernobyl accident occurred when the Ukrainian winter wheat is maturing prior to harvest within the next sixty days. The barley and corn crops would be seeded over this

same period and would be harvested in the fall. Contamination may affect this schedule and the quality of the 1986 winter wheat crop.

While average yield data is not available for the Ukraine, this republic almost exclusively consists of Chernozem type soil, or naturally fertile black earth, that is among the most productive in the USSR. As a result, we can assume that under normal conditions, grain yields in the Ukraine are higher than the Soviet average.

The Ukraine accounts for 13.5% of total Soviet grain area. Assuming that Ukrainian yields are half again ~~three~~ two the Soviet average (estimated by the USDA at 1.61 metric tons per ~~acre~~ hectare) a loss of the full Ukrainian grain crop would reduce total Soviet grain production by a maximum of about 20%. Since not all Oblasts in the republic, notably those in the southeast and extreme southwest, would receive the same amount of contamination, and that other smaller producing republics are also affected, we will assume that the potential maximum loss to the new Soviet crop would be about 10%. Using the current USDA estimate of the 1985 Soviet crop of 190 mmt, this would represent a loss of 19 to 20 mmt or a total crop of about 170 mmt.

This outcome would be about the size of the 1984 Soviet crop and would be the third smallest in 12 years. A reduction of this magnitude would not be entirely out of line with extreme weather variations experienced over the past two decades. The major difference might come, however, in a total loss of area due to extreme contamination. Due to the nature of this accident this appears unlikely in all but the land immediately surrounding the plant location. As a result, we do not expect that this will be a major problem for future crops.

**Livestock**

The Ukraine has the second largest livestock inventories in the USSR, and accounts for a significant amount of total milk production. Radioactivity will contaminate milk production in virtually all exposed areas. The severity of the contamination will determine whether livestock herds will be have to be liquidated. The key to keep in mind is that a liquidation of livestock will reduce animal numbers and, consequently, the base of feed demand and grain imports next year. A severe contamination of milk production will likely force the Soviets to import dry milk and dairy products, most likely from the European Community. Traditionally, the Soviets have also increased imports of vegetable oils such as soybean oil to augment a shortfall in animal fat and butter production. If this were the case, these imports would likely come from the U.S.

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**Table 2**

**Soviet Union**
**Livestock Numbers by Republic - January 1, 1985**
**(Million Head)**

| | Cattle | Cows | Hogs | Poultry |
|---|---|---|---|---|
| RSFSR | 60.0 | 22.0 | 38.7 | 616.7 |
| UKRAINE | 26.7 | 9.0 | 20.9 | 251.3 |
| KAZAKHSTAN | 9.0 | 3.2 | 2.7 | 52.3 |
| BYELORUSSIA | 7.6 | 2.7 | 5.0 | 44.3 |
| OTHERS | 17.7 | 6.7 | 10.6 | 178.4 |
| TOTAL | 121.0 | 43.6 | 77.9 | 1143.0 |

Source: Narodnoe Khozvaistvo, USSR, 1984

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**Impact on World Food Security**

The impact of the Chernobyl disaster is also not likely to have a severe adverse impact on world food supplies. The world is currently faced with record stocks of wheat and coarse grains. According to USDA/FAS data and estimates, global wheat supplies at the end of the current marketing year will total a record 127.7 mmt or almost 25% of world demand. This is the largest stock demand ratio in the past decade. This oversupply condition, largely accounted for by increases in output among importers, has been a major factor behind the recent decline in the total level of world wheat trade.

Similarly, world coarse grain stocks are projected to total a record 162.1 mmt, with the stock demand ratio -- the indication of how much demand can be met with stocks -- topping out at a two decade record of 20.9%.

The point of these statistics is that the world grain markets could absorb a 10% decline in Soviet production with relatively little impact on prices or availabilities for other importers.

Supplies of dairy products in the EC intervention stockpiles should be more than adequate to meet increased import demand from the USSR and East European countries affected by the accident. These stockpiles will also help offset any losses experienced by the Scandanavian or other European countries. In fact, the drawdown of these stocks may actually strengthen the EC by reducing costly inventories and boosting a dismal global export outlook.

**Impact on United States Agriculture**

The U.S. may experience increased Soviet demand for grain and soybean oil as a result of the Chernobyl disaster. Since any major impact on Soviet grain is most likely to be on Ukrainian wheat, the Soviets may be forced to increase wheat imports. This is likely to benefit the European Community (France), Canada, and Argentina more than the United States. Since the USSR is not eligible for price incentives provided by the USDA export enhancement program BICEP, the Soviets in effect pay a premium for U.S. wheat. With more than enough wheat available from our competitors, the Soviets have been buying it elsewhere. This is unlikely to change in the near term.

Wharton Econometrics currently projects the USSR to buy 4.35 mmt (160 million bushels) of wheat during the 1986/87 season. A shortfall of 10% in the Soviet harvest may result in as much as an additional 20 mmt of grain imported with the majority accounted for by wheat. If the Soviets increased imports of wheat from the U.S. by an additional 2 mmt ( 78 million bushels) next season, the U.S. farm price of wheat would increase 14 cents per bushel to $2.64 for the 1986/87 season. Reflecting a loss of area during the next several years for the USSR, we have assumed an additional 1 mmt (36.7 million bushel) increase in Soviet imports over the next three years. This would increase wheat prices annually through 1990.

The USSR has been a major buyer of U.S. coarse grains, primarily corn. Since the Ukraine accounts for again about 13% of Soviet corn and barley area, and that the U.S. is the largest supplier of coarse grains, we expect that Soviet coarse grain imports form the U.S. might increase by an additional 5 mmt (197 million bushels) next season, and 2 mmt (79 million bushels) during each of the next three years. Increases of this magnitude over baseline levels of 300 million bushels per year of corn exports would increase U.S. corn prices by 35 cents per bushel during 1986/87 to $2.33. Similarly, increased exports over

the next several years would boost prices to $2.32 by 1990, compared with a baseline of $2.05.

Increased export activity and somewhat higher prices would provide a much needed boost to farm cash receipts and net farm income. The increases indicated above would increase U.S. crop cash receipts beginning in 1987 by $2.3 billion. As prices rise, both receipts and net farm income would increase. A higher level of Soviet imports would help boost net farm income by $6.1 billion between 1987 and 1990.

These outcomes are illustrated in the attached supply and utilization, and farm income tables for the United States.

**Conclusion**

The Chernobyl nuclear accident is clearly a disaster for the Soviet Union. It is unlikely, however, to result in a larger decline in Soviet grain production than might be expected by recurring adverse weather conditions. The Soviets may find it necessary to increase imports of grain, dairy products, and possibly meat. In the case of increased dairy and meat imports, the most likely beneficiaries will be the EC and possibly East Europe, notably Poland and Hungary. The Soviets will likely continue to increase wheat imports from non-U.S. sources, but rely on the U.S. for additional coarse grains.

# APPENDIX 1

## U.S. SUPPLY AND UTILIZATION TABLES

## BASELINE VERSUS INCREASED SOVIET IMPORTS

## WHEAT, CORN, AND SOYBEAN

WHARTON/FAPRI SPRING 1986 LONG TERM BASELINE -- U.S. WHEAT

| Variable/Year | 84/85 | 85/86 | 86/87 | 87/88 | 88/89 | 89/90 | 90/91 |
|---|---|---|---|---|---|---|---|
| ACREAGE: | | | | | (Million Acres) | | |
| Base Acres | 93.3 | 93.3 | 91.3 | 91.3 | 91.3 | 91.3 | 91.3 |
| LTCR Acres | 0.00 | 0.00 | 2.8 | 8.2 | 13.7 | 18.9 | 24.1 |
| ARP (percent) | 20% | 20% | 23% | 28% | 30% | 25% | 20% |
| Paid Diversion | 10% | 10% | 10% | 0% | 0% | 0% | 0% |
| Partic. Rate | | 74% | 81% | 83% | 85% | 85% | 73% |
| Set Aside Acres | 0.0 | 0.0 | 23.3 | 19.0 | 19.8 | 15.4 | 9.7 |
| Planted Area | 79.2 | 75.6 | 72.1 | 68.4 | 62.0 | 57.9 | 60.2 |
| Harvested Area | 66.9 | 64.7 | 64.0 | 60.9 | 55.2 | 51.5 | 53.6 |
| Yield | 38.8 | 37.5 | 37.8 | 38.2 | 38.7 | 39.1 | 39.5 |
| Base Yield | 34.7 | 36.3 | 37.1 | 37.1 | 38.4 | 38.2 | 38.3 |
| SUPPLY | | | | | (Million Bushels) | | |
| Beg. Stocks | 1,399 | 1,426 | 1,809 | 1,985 | 2,105 | 1,903 | 1,487 |
| Production | 2,595 | 2,429 | 2,422 | 2,328 | 2,133 | 2,013 | 2,114 |
| Imports | 9 | 12 | 2 | 2 | 2 | 2 | 2 |
| TOTAL SUPPLY | 4,003 | 3,864 | 4,233 | 4,315 | 4,240 | 3,919 | 3,603 |
| DOMESTIC | | | | | | | |
| Feed | 410 | 325 | 381 | 274 | 299 | 306 | 308 |
| Food | 650 | 660 | 689 | 692 | 699 | 705 | 711 |
| Seed, Etc. | 93 | 90 | 86 | 78 | 73 | 76 | 82 |
| TOTAL | 1,153 | 1,075 | 1,156 | 1,044 | 1,071 | 1,087 | 1,102 |
| EXPORTS | | | | | | | |
| USSR & PRC | 333 | 147 | 160 | 156 | 165 | 165 | 165 |
| PL480 & AID | 160 | 170 | 165 | 165 | 165 | 165 | 165 |
| Commercial | 931 | 663 | 767 | 844 | 936 | 1,015 | 1,075 |
| TOTAL | 1,424 | 980 | 1,092 | 1,165 | 1,266 | 1,345 | 1,405 |
| TOTAL DEMAND | 2,577 | 2,055 | 2,248 | 2,209 | 2,337 | 2,432 | 2,506 |
| ENDING STOCKS | 1,426 | 1,809 | 1,985 | 2,105 | 1,903 | 1,487 | 1,097 |
| Farmer Held | 654 | 498 | 440 | 394 | 354 | 300 | 240 |
| CCC Owned | 378 | 640 | 753 | 946 | 846 | 625 | 385 |
| Under Loan | 175 | 520 | 620 | 413 | 309 | 225 | 155 |
| "Free" Stocks | 219 | 151 | 172 | 352 | 394 | 562 | 472 |
| PRICES: | | | | | ($/Bushel) | | |
| Farm Price | $3.38 | $3.00 | $2.50 | $2.36 | $2.30 | $2.37 | $2.40 |
| Loan Rate | $3.30 | $3.30 | $2.40 | $2.28 | $2.17 | $2.18 | $2.19 |
| Target Price | $4.38 | $4.38 | $4.38 | $4.38 | $4.29 | $4.16 | $3.95 |
| Reserve Entry | $3.30 | $3.30 | $2.40 | $2.28 | $2.17 | $2.18 | $2.19 |
| Reserve Release | $4.45 | $4.45 | $4.45 | $4.45 | $4.45 | $4.45 | $4.45 |
| Cost per Acre | $70.35 | $68.54 | $64.95 | $67.4[illegible] | $70.85 | $75.32 | $81.04 |
| Cost per Bushel | $1.81 | $1.83 | $1.72 | $1.77 | $1.83 | $1.93 | $2.05 |

CHERNOBYL DISASTER: INCREASED SOVIET IMPORTS -- U.S. WHEAT

| Variable/Year | 84/85 | 85/86 | 86/87 | 87/88 | 88/89 | 89/90 | 90/91 |
|---|---|---|---|---|---|---|---|
| ACREAGE: | | | | | (Million Acres) | | |
| Base Acres | 93.3 | 93.3 | 91.3 | 91.3 | 91.3 | 91.3 | 91.3 |
| LTCR Acres | 0.00 | 0.00 | 2.8 | 8.2 | 13.7 | 18.9 | 24.1 |
| ARP (percent) | 20% | 20% | 23% | 28% | 30% | 25% | 20% |
| Paid Diversion | 10% | 10% | 10% | 0% | 0% | 0% | 0% |
| Partic. Rate | | 74% | 81% | 83% | 85% | 85% | 73% |
| Set Aside Acres | 0.0 | 0.0 | 23.3 | 19.0 | 19.8 | 15.4 | 9.7 |
| Planted Area | 79.2 | 75.6 | 72.1 | 68.4 | 62.0 | 57.9 | 60.2 |
| Harvested Area | 66.9 | 64.7 | 64.0 | 60.9 | 55.2 | 51.5 | 53.6 |
| Yield | 38.8 | 37.5 | 37.8 | 38.2 | 38.7 | 39.1 | 39.5 |
| Base Yield | 34.7 | 36.3 | 37.1 | 37.1 | 38.4 | 38.2 | 38.3 |
| SUPPLY | | | | | (Million Bushels) | | |
| Beg. Stocks | 1,399 | 1,426 | 1,809 | 1,912 | 1,996 | 1,759 | 1,307 |
| Production | 2,595 | 2,429 | 2,422 | 2,328 | 2,133 | 2,013 | 2,114 |
| Imports | 9 | 12 | 2 | 2 | 2 | 2 | 2 |
| TOTAL SUPPLY | 4,003 | 3,864 | 4,233 | 4,242 | 4,132 | 3,774 | 3,423 |
| DOMESTIC | | | | | | | |
| Feed | 410 | 325 | 381 | 274 | 299 | 306 | 308 |
| Food | 650 | 660 | 689 | 692 | 699 | 705 | 711 |
| Seed, Etc. | 93 | 90 | 86 | 78 | 73 | 76 | 82 |
| TOTAL | 1,153 | 1,075 | 1,156 | 1,044 | 1,071 | 1,087 | 1,102 |
| EXPORTS | | | | | | | |
| USSR & PRC | 333 | 147 | 233 | 192 | 201 | 201 | 165 |
| PL480 & AID | 160 | 170 | 165 | 165 | 165 | 165 | 165 |
| Commercial | 931 | 663 | 767 | 844 | 936 | 1,015 | 1,075 |
| TOTAL | 1,424 | 980 | 1,165 | 1,201 | 1,302 | 1,381 | 1,405 |
| TOTAL DEMAND | 2,577 | 2,055 | 2,321 | 2,245 | 2,373 | 2,468 | 2,506 |
| ENDING STOCKS | 1,426 | 1,809 | 1,912 | 1,996 | 1,759 | 1,307 | 917 |
| Farmer Held | 654 | 498 | 440 | 394 | 325 | 275 | 225 |
| CCC Owned | 378 | 640 | 653 | 846 | 746 | 475 | 250 |
| Under Loan | 175 | 520 | 620 | 413 | 309 | 225 | 155 |
| "Free" Stocks | 219 | 151 | 199 | 344 | 379 | 557 | 442 |
| PRICES: | | | | | ($/Bushel) | | |
| Farm Price | $3.38 | $3.00 | $2.64 | $2.57 | $2.48 | $2.57 | $2.65 |
| Loan Rate | $3.30 | $3.30 | $2.40 | $2.28 | $2.17 | $2.18 | $2.19 |
| Target Price | $4.38 | $4.38 | $4.38 | $4.38 | $4.29 | $4.16 | $3.95 |
| Reserve Entry | $3.30 | $3.30 | $2.40 | $2.28 | $2.17 | $2.18 | $2.19 |
| Reserve Release | $4.45 | $4.45 | $4.45 | $4.45 | $4.45 | $4.45 | $4.45 |
| Cost per Acre | $70.35 | $68.54 | $64.95 | $67.49 | $70.85 | $75.32 | $81.04 |
| Cost per Bushel | $1.81 | $1.83 | $1.72 | $1.77 | $1.83 | $1.93 | $2.05 |

WHARTON/FAPRI SPRING 1986 LONG TERM BASELINE -- U.S. CORN

| Variable/Year | 84/85 | 85/86 | 86/87 | 87/88 | 88/89 | 89/90 | 90/91 |
|---|---|---|---|---|---|---|---|
| ACREAGE: | | | | | (Million Acres) | | |
| Base Acres | 83.3 | 83.3 | 83.3 | 83.3 | 83.3 | 83.3 | 83.3 |
| Set Aside % | 10.0% | 10.0% | 17.5% | 20.0% | 20.0% | 20.0% | 20.0% |
| Diversion % | 0.0% | 0.0% | 2.5% | 0.0% | 0.0% | 0.0% | 0.0% |
| LTCR Acres | 0.0 | 0.0 | 1.0 | 2.2 | 3.3 | 5.2 | 7.0 |
| Set Aside Acres | 8.3 | 8.3 | 12.4 | 13.0 | 13.1 | 12.8 | 12.5 |
| Diversion Acres | 0.0 | 0.0 | 2.1 | 0.0 | 0.0 | 0.0 | 0.0 |
| Partic. Rate | 69% | 71% | 76% | 80% | 82% | 82% | 82% |
| Planted Area | 80.5 | 83.3 | 75.5 | 74.5 | 73.5 | 72.3 | 71.0 |
| Harvested Area | 71.9 | 75.1 | 66.4 | 65.6 | 64.7 | 63.6 | 62.5 |
| Yield | 106.7 | 118.0 | 114.0 | 115.0 | 116.0 | 120.2 | 121.5 |
| Base Yield | 102.0 | 100.2 | 105.6 | 105.3 | 107.0 | 113.9 | 106.4 |
| SUPPLY | | | | | (Million Bushels) | | |
| Beg. Stocks | 723 | 1,381 | 3,402 | 3,570 | 3,536 | 3,298 | 3,048 |
| Production | 7,674 | 8,865 | 7,572 | 7,541 | 7,504 | 7,647 | 7,591 |
| Imports | 3 | 2 | 1 | 1 | 1 | 1 | 1 |
| TOTAL SUPPLY | 8,400 | 10,248 | 10,976 | 11,112 | 11,042 | 10,946 | 10,640 |
| DOMESTIC | | | | | | | |
| Feed | 4,116 | 4,100 | 4,492 | 4,549 | 4,595 | 4,577 | 4,623 |
| Food | 858 | 880 | 905 | 923 | 942 | 984 | 1,004 |
| Gasohol | 185 | 220 | 257 | 290 | 319 | 351 | 363 |
| Seed | 22 | 20 | 20 | 20 | 19 | 19 | 19 |
| TOTAL | 5,181 | 5,220 | 5,674 | 5,782 | 5,875 | 5,931 | 6,009 |
| EXPORTS | | | | | | | |
| USSR | 589 | 275 | 300 | 300 | 300 | 300 | 300 |
| PL480 & AID | 25 | 35 | 35 | 35 | 35 | 35 | 35 |
| Commercial | 1,224 | 1,315 | 1,397 | 1,459 | 1,534 | 1,632 | 1,670 |
| TOTAL | 1,838 | 1,625 | 1,732 | 1,794 | 1,869 | 1,967 | 2,005 |
| TOTAL DEMAND | 7,019 | 6,845 | 7,406 | 7,576 | 7,744 | 7,898 | 8,014 |
| ENDING STOCKS | 1,381 | 3,402 | 3,570 | 3,536 | 3,298 | 3,048 | 2,626 |
| Farmer Held | 437 | 635 | 623 | 449 | 272 | 260 | 50 |
| CCC Owned | 240 | 510 | 1,871 | 1,805 | 1,631 | 1,258 | 1,120 |
| Under Loan | 567 | 1,850 | 425 | 358 | 370 | 354 | 255 |
| "Free" Stocks | 137 | 407 | 652 | 924 | 1,025 | 1,176 | 1,201 |
| PRICES: | | | | | ($/Bu) | | |
| Farm Price | $2.62 | $2.37 | $1.98 | $1.87 | $1.82 | $1.89 | $2.05 |
| Chicago Price | $2.74 | $2.57 | $2.16 | $2.05 | $1.99 | $2.07 | $2.24 |
| Loan Rate | $2.55 | $2.55 | $1.92 | $1.82 | $1.73 | $1.65 | $1.56 |
| Target Price | $3.03 | $3.03 | $3.03 | $3.03 | $2.97 | $2.88 | $2.74 |
| Reserve Entry | $2.55 | $2.55 | $1.92 | $1.82 | $1.73 | $1.65 | $1.56 |
| Reserve Release | $3.25 | $3.25 | $3.25 | $3.25 | $3.25 | $3.25 | $3.25 |
| Cost per Acre | $160.42 | $154.02 | $143.13 | $147.91 | $154.86 | $163.78 | $175.26 |
| Cost per Bushel | $1.50 | $1.31 | $1.26 | $1.29 | $1.33 | $1.36 | $1.44 |

CHERNOBYL DISASTER: INCREASED SOVIET IMPORTS -- U.S. CORN

| Variable/Year | 84/85 | 85/86 | 86/87 | 87/88 | 88/89 | 89/90 | 90/91 |
|---|---|---|---|---|---|---|---|
| ACREAGE: | | | | | (Million Acres) | | |
| Base Acres | 83.3 | 83.3 | 83.3 | 83.3 | 83.3 | 83.3 | 83.3 |
| Set Aside % | 10.0% | 10.0% | 17.5% | 20.0% | 20.0% | 20.0% | 20.0% |
| Diversion % | 0.0% | 0.0% | 2.5% | 0.0% | 0.0% | 0.0% | 0.0% |
| LTCR Acres | 0.0 | 0.0 | 1.0 | 2.2 | 3.3 | 5.2 | 7.0 |
| Set Aside Acres | 8.3 | 8.3 | 12.4 | 13.0 | 13.1 | 12.8 | 12.5 |
| Diversion Acres | 0.0 | 0.0 | 2.1 | 0.0 | 0.0 | 0.0 | 0.0 |
| Partic. Rate | 69% | 71% | 76% | 80% | 82% | 82% | 82% |
| Planted Area | 80.5 | 83.3 | 75.5 | 74.5 | 73.5 | 72.3 | 71.0 |
| Harvested Area | 71.9 | 75.1 | 66.4 | 65.6 | 64.7 | 63.6 | 62.5 |
| Yield | 106.7 | 118.0 | 114.0 | 115.0 | 116.0 | 120.2 | 121.5 |
| Base Yield | 102.0 | 100.2 | 105.6 | 105.3 | 107.0 | 113.9 | 106.4 |
| SUPPLY | | | | | (Million Bushels) | | |
| Beg. Stocks | 723 | 1,381 | 3,402 | 3,373 | 3,260 | 2,943 | 2,614 |
| Production | 7,674 | 8,865 | 7,572 | 7,541 | 7,504 | 7,647 | 7,591 |
| Imports | 3 | 2 | 1 | 1 | 1 | 1 | 1 |
| TOTAL SUPPLY | 8,400 | 10,248 | 10,976 | 10,915 | 10,766 | 10,591 | 10,206 |
| DOMESTIC | | | | | | | |
| Feed | 4,116 | 4,100 | 4,492 | 4,549 | 4,595 | 4,577 | 4,623 |
| Food | 858 | 880 | 905 | 923 | 942 | 984 | 1,004 |
| Gasohol | 185 | 220 | 257 | 290 | 319 | 351 | 363 |
| Seed | 22 | 20 | 20 | 20 | 19 | 19 | 19 |
| TOTAL | 5,181 | 5,220 | 5,674 | 5,782 | 5,875 | 5,931 | 6,009 |
| EXPORTS | | | | | | | |
| USSR | 589 | 275 | 497 | 379 | 379 | 379 | 300 |
| PL480 & AID | 25 | 35 | 35 | 35 | 35 | 35 | 35 |
| Commercial | 1,224 | 1,315 | 1,397 | 1,459 | 1,534 | 1,632 | 1,670 |
| TOTAL | 1,838 | 1,625 | 1,929 | 1,873 | 1,948 | 2,046 | 2,005 |
| TOTAL DEMAND | 7,019 | 6,845 | 7,603 | 7,655 | 7,823 | 7,977 | 8,014 |
| ENDING STOCKS | 1,381 | 3,402 | 3,373 | 3,260 | 2,943 | 2,614 | 2,192 |
| Farmer Held | 437 | 635 | 623 | 449 | 272 | 260 | 50 |
| CCC Owned | 240 | 510 | 1,871 | 1,705 | 1,331 | 958 | 820 |
| Under Loan | 567 | 1,850 | 425 | 358 | 370 | 354 | 255 |
| "Free" Stocks | 137 | 407 | 455 | 748 | 970 | 1,042 | 1,067 |
| PRICES: | | | | | ($/Bu) | | |
| Farm Price | $2.62 | $2.37 | $2.33 | $2.19 | $1.98 | $2.18 | $2.32 |
| Chicago Price | $2.74 | $2.57 | $2.54 | $2.38 | $2.16 | $2.38 | $2.52 |
| Loan Rate | $2.55 | $2.55 | $1.92 | $1.82 | $1.73 | $1.65 | $1.56 |
| Target Price | $3.03 | $3.03 | $3.03 | $3.03 | $2.97 | $2.88 | $2.74 |
| Reserve Entry | $2.55 | $2.55 | $1.92 | $1.82 | $1.73 | $1.65 | $1.56 |
| Reserve Release | $3.25 | $3.25 | $3.25 | $3.25 | $3.25 | $3.25 | $3.25 |
| Cost per Acre | $160.42 | $154.02 | $143.13 | $147.91 | $154.86 | $163.78 | $175.26 |
| Cost per Bushel | $1.50 | $1.31 | $1.26 | $1.29 | $1.33 | $1.36 | $1.44 |

WHARTON/FAPRI SPRING 1986 LONG TERM BASELINE -- U.S. SOYBEANS

| Variable/Year | 84/85 | 85/86 | 86/87 | 87/88 | 88/89 | 89/90 | 90/91 |
|---|---|---|---|---|---|---|---|
| ACREAGE: | | | | | (Million Acres) | | |
| LTCR Acres | 0 | 0 | 1.2 | 2.5 | 3.7 | 5.9 | 8.14 |
| Planted Area | 67.7 | 63.1 | 63.0 | 63.0 | 65.0 | 66.0 | 67.1 |
| Harvested Area | 66.1 | 61.6 | 62.0 | 62.0 | 64.0 | 65.0 | 66.1 |
| Yield (Bu/Acre) | 28.2 | 34.1 | 31.3 | 31.7 | 32.1 | 32.5 | 32.9 |
| SUPPLY | | | | | (Million Bushels) | | |
| Beg. Stocks | 176 | 316 | 522 | 504 | 401 | 343 | 257 |
| Production | 1,861 | 2,101 | 1,941 | 1,965 | 2,054 | 2,113 | 2,175 |
| TOTAL SUPPLY | 2,037 | 2,417 | 2,462 | 2,469 | 2,455 | 2,456 | 2,432 |
| DOMESTIC | | | | | | | |
| Crush | 1,030 | 1,060 | 1,119 | 1,153 | 1,173 | 1,186 | 1,176 |
| Seed & Residual | 91 | 85 | 90 | 90 | 90 | 90 | 90 |
| TOTAL | 1,121 | 1,145 | 1,209 | 1,243 | 1,263 | 1,276 | 1,266 |
| EXPORTS | | | | | | | |
| USSR | 0 | 18 | 4 | 9 | 16 | 22 | 24 |
| Commercial | 598 | 732 | 746 | 816 | 843 | 901 | 907 |
| TOTAL | 598 | 750 | 750 | 825 | 849 | 923 | 931 |
| TOTAL DEMAND | 1,720 | 1,895 | 1,959 | 2,068 | 2,112 | 2,199 | 2,197 |
| ENDING STOCKS | 318 | 522 | 504 | 401 | 343 | 257 | 235 |
| CCC Owned | 32 | 175 | 150 | 75 | 35 | 0 | 0 |
| "Free" Stocks | 286 | 347 | 354 | 326 | 308 | 257 | 235 |
| PRICES: | | | | | ($/Bushel) | | |
| Farm Price | $5.85 | $5.28 | $4.96 | $4.85 | $4.84 | $5.04 | $5.44 |
| Chicago Price | $5.88 | $5.36 | $5.03 | $4.91 | $4.90 | $5.12 | $5.54 |
| Loan Rate | $5.02 | $5.02 | $4.77 | $4.77 | $4.77 | $4.50 | $4.50 |
| Bean/Corn Ratio | 2.23 | 2.22 | 2.51 | 2.59 | 2.67 | 2.66 | 2.66 |
| Cost per Acre | $76.99 | $75.22 | $72.27 | $74.15 | $77.37 | $82.08 | $88.31 |
| Cost per Bushel | $2.73 | $2.21 | $2.31 | $2.34 | $2.41 | $2.53 | $2.68 |
| Return/Bu. | $3.12 | $3.07 | $2.65 | $2.51 | $2.43 | $2.52 | $2.76 |
| Return/Acre | $87.99 | $104.82 | $83.06 | $79.47 | $78.00 | $81.81 | $90.77 |

CHERNOBYL DISASTER: INCREASED SOVIET IMPORTS -- U.S. SOYBEANS

| Variable/Year | 84/85 | 85/86 | 86/87 | 87/88 | 88/89 | 89/90 | 90/91 |
|---|---|---|---|---|---|---|---|
| ACREAGE: | | | | | (Million Acres) | | |
| LTCR Acres | | 0 | 1.2 | 2.5 | 3.7 | 5.9 | 8.14 |
| Planted Area | 67.7 | 63.1 | 63.0 | 63.0 | 65.0 | 66.0 | 67.1 |
| Harvested Area | 66.1 | 61.6 | 62.0 | 62.0 | 64.0 | 65.0 | 66.1 |
| Yield (Bu/Acre) | 28.2 | 34.1 | 31.3 | 31.7 | 32.1 | 32.5 | 32.9 |
| SUPPLY | | | | | (Million Bushels) | | |
| Beg. Stocks | 176 | 316 | 522 | 504 | 401 | 343 | 257 |
| Production | 1,861 | 2,101 | 1,941 | 1,965 | 2,054 | 2,113 | 2,175 |
| TOTAL SUPPLY | 2,037 | 2,417 | 2,462 | 2,469 | 2,455 | 2,456 | 2,432 |
| DOMESTIC | | | | | | | |
| Crush | 1,030 | 1,060 | 1,119 | 1,153 | 1,173 | 1,186 | 1,176 |
| Seed & Residual | 91 | 85 | 90 | 90 | 90 | 90 | 90 |
| TOTAL | 1,121 | 1,145 | 1,209 | 1,243 | 1,263 | 1,276 | 1,266 |
| EXPORTS | | | | | | | |
| USSR | 0 | 18 | 4 | 9 | 16 | 22 | 24 |
| Commercial | 598 | 732 | 746 | 816 | 843 | 901 | 907 |
| TOTAL | 598 | 750 | 750 | 825 | 849 | 923 | 931 |
| TOTAL DEMAND | 1,720 | 1,895 | 1,959 | 2,068 | 2,112 | 2,199 | 2,197 |
| ENDING STOCKS | 318 | 522 | 504 | 401 | 343 | 257 | 235 |
| CCC Owned | 32 | 175 | 150 | 75 | 35 | 0 | 0 |
| "Free" Stocks | 286 | 347 | 354 | 326 | 308 | 257 | 235 |
| PRICES: | | | | | ($/Bushel) | | |
| Farm Price | $5.85 | $5.28 | $5.28 | $5.15 | $4.98 | $5.31 | $5.72 |
| Chicago Price | $5.88 | $5.36 | $5.36 | $5.23 | $5.05 | $5.40 | $5.83 |
| Loan Rate | $5.02 | $5.02 | $4.77 | $4.77 | $4.77 | $4.50 | $4.50 |
| Bean/Corn Ratio | 2.23 | 2.22 | 2.26 | 2.35 | 2.51 | 2.43 | 2.46 |
| Cost per Acre | $76.99 | $75.22 | $72.27 | $74.15 | $77.37 | $82.08 | $88.31 |
| Cost per Bushel | $2.73 | $2.21 | $2.31 | $2.34 | $2.41 | $2.53 | $2.68 |
| Return/Bu. | $3.12 | $3.07 | $2.97 | $2.81 | $2.57 | $2.79 | $3.04 |
| Return/Acre | $87.99 | $104.82 | $92.92 | $89.02 | $82.35 | $90.59 | $99.91 |

# APPENDIX 2

## U.S. NET FARM INCOME

## BASELINE VERSUS INCREASED SOVIET IMPORTS

WHARTON/FAPRI SPRING 1986 LONG TERM BASELINE -- U.S. NET FARM INCOME

| Year | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 |
|---|---|---|---|---|---|---|---|
| | | | | | (BILLION CURRENT $) | | |
| Total Farm Cash Receipts | 141.8 | 143.50 | 131.60 | 127.90 | 126.60 | 128.30 | 130.50 |
| Crop Receipts | 69.10 | 73.90 | 62.60 | 60.40 | 61.20 | 63.30 | 66.60 |
| Livestock Receipts | 72.70 | 69.60 | 69.00 | 67.50 | 65.40 | 65.00 | 63.90 |
| Direct Govt. Payments | 8.60 | 8.50 | 9.80 | 14.20 | 14.80 | 14.50 | 12.60 |
| Non-Money and Other -- Farm Income | 15.80 | 15.10 | 15.50 | 15.20 | 15.10 | 15.40 | 15.30 |
| Realized Gross -- Farm Income | 166.20 | 167.10 | 156.90 | 157.30 | 156.50 | 158.20 | 158.40 |
| Production Expenses | 139.50 | 135.70 | 129.90 | 127.70 | 126.30 | 129.00 | 132.60 |
| Net Farm Income Before -- Inventory Adj. | 26.70 | 31.40 | 27.00 | 29.60 | 30.20 | 29.20 | 25.80 |
| Value of Inventory Adj. | 7.80 | 0.46 | -0.64 | 0.43 | -0.86 | -0.26 | -0.82 |
| Net Farm Income | 34.50 | 31.86 | 26.36 | 30.03 | 29.34 | 28.94 | 24.98 |

CHERNOBYL DISASTER: INCREASED SOVIET IMPORTS SCENARIO -- U.S. NET FARM INCOME

| Year | 1984 | 1985 | 1986 | 1987 | 1988 | 1989 | 1990 |
|---|---|---|---|---|---|---|---|
| | | | | | (BILLION CURRENT $) | | |
| Total Farm Cash Receipts | 141.8 | 143.50 | 131.60 | 130.58 | 130.07 | 130.71 | 133.36 |
| Crop Receipts | 69.10 | 73.90 | 62.60 | 63.08 | 64.67 | 65.71 | 69.46 |
| Livestock Receipts | 72.70 | 69.60 | 69.00 | 67.50 | 65.40 | 65.00 | 63.90 |
| Direct Govt. Payments | 8.60 | 8.50 | 9.80 | 13.20 | 13.80 | 13.20 | 10.60 |
| Non-Money and Other -- Farm Income | 15.80 | 15.10 | 15.50 | 15.20 | 15.10 | 15.40 | 15.30 |
| Realized Gross -- Farm Income | 166.20 | 167.10 | 156.90 | 158.98 | 158.97 | 159.31 | 159.26 |
| Production Expenses | 139.50 | 135.70 | 129.90 | 127.70 | 126.30 | 129.00 | 132.60 |
| Net Farm Income Before -- Inventory Adj. | 26.70 | 31.40 | 27.00 | 31.28 | 32.67 | 30.31 | 26.66 |
| Value of Inventory Adj. | 7.80 | 0.46 | -0.64 | 0.43 | -0.86 | -0.26 | -0.82 |
| Net Farm Income | 34.50 | 31.86 | 26.36 | 31.71 | 31.81 | 30.05 | 25.84 |

Senator ABDNOR. Well, thank you. We really appreciate your being here again today. We will be asking you questions, but I guess, overall, we could say there is nothing that dramatic at the forefront in your analysis and assumptions.

Mr. URBANCHUK. On the assumptions that we've made, no. Hopefully, some of the other experts here can shed some technical light on the situation.

Senator ABDNOR. Well, I am very pleased to say our next witness, I am sure, will give us an insight. As I said, we have Prof. Miro Todorovich, who is executive director of Scientists and Engineers for Secure Energy, out of New York. I want to get that straight. And we're happy to have you.

**STATEMENT OF MIRO M. TODOROVICH, EXECUTIVE DIRECTOR, SCIENTISTS AND ENGINEERS FOR SECURE ENERGY, INC., AND PHYSICS PROFESSOR, CITY UNIVERSITY OF NEW YORK**

Mr. TODOROVICH. Yes, I like to be called Miro.

Senator ABDNOR. Oh, pardon me. [Laughter.]

Mr. TODOROVICH. And I am also a physics professor, so I will try to add some insight into what perhaps we can do and what we cannot do, what we can expect and what we cannot expect, all hopefully, as a contribution to the understanding by people in Government, in Congress who know much more about agriculture than I do, but who nevertheless need some factual grounds on which to base their decisions.

This particular situation is really fraught with uncertainties. Let me for a moment just explain where these uncertainties in the scientific arena come from.

We in the United States and in the rest of the Western industrialized world have opted in recent years for a version of nuclear powerplants utilizing basically a mixture, in the reactor vessel, of a fuel, uranium or some other type, within a pool of water, which serves both to slow down the neutrons and to transfer heat to the generators, which then produce electricity.

A powerplant of this kind is, in principle, pretty simple. If there is a calamity, what is known as meltdown, it results in some kind of lava-like sludge, which can reasonably hope to be contained within what is called the containment vessel. And the greatest worry is whether some volatile elements, which are the result of the decay process of uranium, may leak into the atmosphere and cause problems.

To investigate this type of happening, a large number of detailed studies have been carried out in the United States and elsewhere, and so had I been here to talk about something that happened at a French nuclear powerplant or British nuclear powerplant, I would have a much easier job because I could define the options and hopes much better.

What the Soviets have, however, opted to do over a number of years, was to retain, as a second design leg in their program, a type of reactor which, in addition to the needed water and fuel, has also inside the reactor core a large amount of graphite, which is a modification of carbon, a close cousin to coal. And coal can burn, as everybody knows.

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Consequently, if there is something that initiates a meltdown, and it is a different kind of meltdown in those Soviet-designed cases that we would have here, in addition to the nuclear "ashes" that are usually present and that one wants to contain, combustion also occurs, which has a tendency to act as a kind of furnace or volcano, trying to throw these ashes into the atmosphere.

In addition, since the Soviets have not gone in the direction of putting containment vessels around their machinery, once an event of this kind is initiated, there is an easy passageway for the radioactive materials to get from the plantsite into the near vicinity and beyond, as we learned from reports from Scandinavia as soon as 2 days after the event in the Ukraine.

Finally, to the best of my understanding, neither the Soviets nor anyone else in the world has done as closely a detailed safety studies of their kind of reactors as we have done on our types of reactors. Consequently, if you combine this amount of lack of precise information with the notorious secretiveness of the country where the mishap occurred, we have a real problem to decipher what has actually happened. We don't even know whether at this time the event has terminated, whether the happening has been brought under control and for how much more time will the releases continue.

That is the bad news.

The good news is that radioactivity is a phenomenon which can be measured better and easier on any contaminated material than probably any other kind of chemical or other substance known to man.

Therefore, once the products from the Soviet Union, from Western Europe, or from any other country that may have been exposed to the nuclear cloud begin to cross national borders, there is no difficulty checking whether these goods are contaminated, and in addition, not only whether they are contaminated, but with what kind of detailed organic, inorganic or whatever other radioactive material they may contain which may be harmful to humans.

In addition, once we are able to identify what materials we have to deal with, the biological effects of such materials on human beings and other living organisms are extremely well known, so that the key to our posture will be, in my judgment, the information that we can cull from what is going on, so that we can, on our own, establish a data base from which then to proceed. Such a data base can be established, if we are alert, and if we take the necessary steps to gather appropriate data and disseminate them to agencies, governmental or otherwise.

Let me, as to the consequences of the event, point out that the direct radiological fallout effect on agricultural products is not the only situation that one should contemplate, because, in a roundabout way, agriculture may indirectly be equally strongly affected. For example, the general energy production in the world and electricity production, in particular, may be greatly effected by the—if you want to call it—psychological fallout from this nuclear malfunction. This psychological fallout is already quite strongly felt in Western Europe, and I am pretty sure that in the months to come, we will see great attempts made in the United States to put a moratorium on the uses of nuclear power for energy production. This,

in turn, means that we will—if this happens—start experiencing increased pressure again on the consumption of hydrocarbons, particularly crude oil. And as we have learned from the last two decades of debates about energy, hydrocarbons are not only a source of sophisticated energy, but also a very valuable chemical raw material for the production of everything from synthetic fibers for our clothing to the production of chemical fertilizers, which are of great importance for the so-called green revolution in agriculture which has altered the feeding patterns and production pattern in many parts of the world. This in a back-door manner will then affect also our agricultural and other related markets.

As a further example of how these things work in unexpected ways, there is this fact about our current reliance on synthetic fiber production that actually, if we would burn too much oil and not have enough of this raw material to produce as much synthetic fibers as we have been accustomed to in the last several decades, the world would have to turn back to wool and cotton, taking acreage now used for various other agricultural purposes, to try just to replenish again the stock of clothing for the peoples of the world.

I am told that, actually, if all the oil which is now used as raw material for the production of synthetic fibers were diverted to other uses, that there would not be enough grazing land for the sheep and sufficient surfaces for growing cotton to substitute the lost synthetics with the natural fiber materials.

I just described a set of potential consequences that should not be left without being registered somewhere. One needs to understand the complexity of consequences that cascade from one phase of an event to another and still to another.

For example, a further problem with increased reliance and dependence on oil is that an increased amount of funding in oil payment money gets into certain countries which are politically unstable or worse and very often utilize such abundant oil payments from the West for warfare, terrorism or other kinds of mischief, not only against the outsiders, the international community, but also against themselves.

Finally, there are ecological consequences of increased utilization of hydrocarbons consequent to the current nuclear scare. Most of us are, for example, familiar with the "greenhouse effect." What one is not so familiar with is that if some of the concerns expressed in certain scientific circles, including the American Academy of Sciences are correct, and because of the increase of the atmospheric concentrations of $CO_2$, a warming up of the climate goes beyond certain narrower levels, our planet may experience what some of my scientific friends like to call the ultimate meltdown of the polar caps, by which standards even a number of nuclear plant meltdowns would be a very minor problem to handle.

I think, Mr. Chairman, you can imagine what kind of alteration of climate and what influence on American agricultural production and capability of production worldwide would ensue, if we do not continue with the careful balancing of the resources from which we are drawing our overall energy and electrical energy. Therefore, the question of these psychological fear responses abroad and in this country in the wake of the Chernobyl accident must not be frivolously overlooked.

In summary, then, if I may come back to where I started, our greatest problem, perhaps, at this moment, is the uncertainty. Uncertainty means that we have to have contingencies evaluated and become prepared for such contingencies.

I understand that the interagency task force which is in operation at this time within our Government is doing some good work in trying to collect data which will put our population at ease. I would respectfully suggest that in the months to come, this same interagency task force or some other similar monitoring body should more and more turn its attention to gathering, by any means possible, all hard facts that they could cull out from satellite observation, and other intelligence analyses so that we can sort out which of the possibilities that I have tried briefly to discuss are more probable, which are less, and then disseminate such hard analyzed facts as fast as possible to all those agencies inside and outside of our Government that can make use of such data for the benefit of us all.

[The prepared statement of Mr. Todorovich follows:]

## Prepared Statement of Miro M. Todorovich

My name is Miro M. Todorovich, I teach physics at the City University of New York and serve as Executive Director of the Scientists and Engineers for Secure Energy, a nationwide association of mostly academic research scientists and engineers, counting among its members eight Nobel Laureates in Physics and Chemistry. $SE_2$ is dedicated to the prudent advancement of the use of technology for the benefit of mankind. Our members followed with particular care events during and after the malfunction at the Three Mile Island nuclear power plant. $SE_2$ also sponsored, among other activities, a three-day colloquium in 1979 on the possible consequences of a sudden energy cutoff - a meeting whose conclusions were shaped by knowledgeable experts like Hans Bethe, Edward Teller, Ken Davis and George Shultz. These and other activities gathered at the interface of science, technology and public policies during $SE_2$'s ten years of existence form the basis for the assessment of the

observed destruction of the one of the Chernobyl nuclear power units.

Until last week, most knowledgeable scientific and engineering professionals in the Western countries believed the the world has successfully created an efficient, elegant and safe method for the production of electricity by means of nuclear power.

Here in the United States, for example, our experts diligently studied possible pathways to malfunctions, introduced highly conservative assumptions (even in the most improbable accident scenarios) and then proceeded to develop structures which can withstand such postulated calamities. We introduced redundant systems for maintaining the flow of cooling water and redundant sources of auxiliary power. Most of our power reactors operate just with fuel and water, so even in the most unlikely event of a meltdown, the bulk of the harmful residues is expected to settle in the form of a lava-like smelt. To prevent the escape of the gaseous by-products, our designers enclosed the entire reactor and its associated systems into leakproof and explosion-proof containment building. Thus, when the great test of the Three Mile Island was initiated by human error, the designed structures performed very well and the incident, though expensive, ended without harm to humans.

The Soviets, however, did most of the things differently. They continued to employ graphite in many of their reactors even

when elsewhere in the world such cores went out of fashion. Graphite is a combustible material, a modification of carbon, whose burning apparently contributes to the spilling of radioactive ashes high into the atmosphere. Also, the Soviets seem not to have performed truly meaningful safety studies on their types of reactors. They were, therefore, quite unprepared to deal with the trouble when it actually occurred. Finally, Soviet designers failed to put containment buildings over the reactor parts of many of their power plants and thus stations permit easy passage of the radioactive debris from the trouble spot into the surrounding environment and beyond.

Thus happened Chernobyl.

At Three Mile Island, US and foreign journalists had a most open access to the site consistent with precautionary safety. After the initial confusion, data began to flow and state and county governments started to act on the basis of the best available information. No investigative stone was left unturned. As a consequence the public, the officials, and the experts, all became acquainted with the facts and via numerous commissions they summarized the lessons learned and formulated desirable improvements. As a result, the country moved with open eyes and enhanced experience toward the hundredth nuclear power plant and beyond. Debates continue but so does progress.

In contrast, at Chernobyl the Soviet were at first willing to concede only the most obvious verities and what became deduced

from observation abroad. They even withheld data from their Polish and other allies thus forcing these countries to engage in remedial actions on the basis of guesses rather than knowledge. At this writing one cannot even be sure whether the accident had been brought under control and for how long one may expect the emission of radioactivity to continue. What we know about the severity of the problem is derived indirectly from the intensity of the migrating radioactive cloud at considerable distance from the source, from the stated need for bone marrow transplants to radiation victims, and from the reported size of the evacuated population. Statements like the one that the radiation at Chernobyl has decreased by fifty percent - without an indication what the percentage is of - are of very limited usefulness.

Given all these uncertainties and the lack of cooperation by the Soviet Government, it is not an easy task to project possible consequences of a calamitious event which may be still in progress.

Relevant topics may, as a frame for discussion and contingency preparation, be organized in the following set of headings:

1. Direct Effect Within the USSR

   a) Decrease or uncertainty in domestic production of electricity and their effects on export of electricity to COMECON countries.

   b) Shift in domestic energy source allocations with consequences for fuel export.

c) Slowdown in the development of regional heating plants for cold regions of Soviet Europe and Siberia.

d) Dislocation of agricultural crops.

e) Reevaluation in the USSR of the role of scientific and technological dissent and of governmental secrecy.

2. Direct Effects Outside the USSR

a) Probably very small changes or delays in European nuclear planning.

b) Same for Japan and Canada.

c) Significant loss of Soviet credibility on all relevant questions of concern.

d) In the US a more directly articulated confrontation on all things nuclear.

3. World Security

a) An increased re-reliance on oil will have destabilizing international repercutions.

b) Hightened consumption and prices of oil make available more war-moneys and terrorist funds in the Middle East and other volatile parts of the world.

c) Underdeveloped countries will have less power for economic reconstruction and will increasingly rely on international welfare.

4. World Economy and Environment

a) Faster consumption of hydrocarbons will (i) enhance the greenhouse menace (the threat of the ultimate meltdown of the polar caps being incomparably more serious than any number of ordinary nuclear meltdowns) and (ii) exacerbate current acid rain and similar pollutions.

b) Faster burning of hydrocarbons (including coal and natural gas) will deplete the nonrenewable chemical sources for (i) synthetic fibers, (ii) plastics, (iii) fertilizers maintaining the Green Revolution.

Each of the delineated areas will experience an impact dependent on:

- the established severity of the Chernobyl trouble,
- the total duraction of the calamity,
- the detailed extent and origin of specific category of damage related to the above listed topics.

The Interagency Task Force could render great service by selectively channeling best available information and analysis to interested and affected parties in and out of the government.

Senator ABDNOR. Well, thank you, Mr. Todorovich.

Since we have started his hearing, one of our very able members of the subcommittee, Senator Mattingly, has joined us. We are happy to have you, Senator.

Do you have any—well I tell you what, we will let you start with comments in general and questions.

Senator MATTINGLY. Thank you, Mr. Chairman. I do have an opening statement for the record.

[The written opening statement of Senator Mattingly follows:]

## Written Opening Statement of Senator Mattingly

MR. CHAIRMAN:

I WANT TO JOIN YOU IN WELCOMING OUR WITNESSES HERE TODAY AS WE ATTEMPT TO FIND WHETHER OR NOT THERE IS, OR WILL BE, A CONNECTION BETWEEN FUTURE EXPORT LEVELS OF UNITED STATES AGRICULTURAL PRODUCTS TO THE U.S.S.R. DUE TO LOSSES WHICH THEY MAY HAVE SUSTAINED IN THE UNFORTUNATE TRAGEDY AT CHERNOBYL. REALIZING THAT IT IS STILL FAR TOO EARLY TO KNOW WITH PRECISION JUST WHAT THE EXTENT OF THESE LOSSES WILL BE, IT IS NOT TOO SOON TO BEGIN ASSESSING THE SITUATION IN AN EFFORT TO IDENTIFY WHAT KIND OF PRODUCTS MAY BE IN SHORT SUPPLY IN COMING MONTHS -- OR YEARS -- IN THE SOVIET UNION, AND HOW OUR PRODUCERS MIGHT CAPTURE A FAIR SHARE OF THIS INCREASED MARKET FOR AMERICAN COMMODITIES AND PRODUCTS.

I WILL ALSO BE INTERESTED TO DETERMINE WHETHER OR NOT THIS EVENT MIGHT ALLOW US TO REDUCE SOME OF OUR CURRENT STOCKPILES OF COMMODITIES WHICH HAVE BUILT UP UNDER VARIOUS PRICE SUPPORT PROGRAMS. I WOULD NOT WANT TO SEE SUCH SURPLUS PRODUCTS TAKE AN UNFAIR PORTION OF ANY INCREASED EXPORTS TO RUSSIA AND OTHER AFFECTED EASTERN EUROPEAN AREAS. HOWEVER, I THINK THAT IT IS REASONABLE THAT THE AMERICAN TAXPAYER SHOULD HAVE AN OPPORTUNITY TO BENEFIT BY REDUCING THE SIZE OF GOVERNMENT-OWNED AGRICULTURAL STOCKPILES AT THE SAME TIME THAT PRODUCERS OF CURRENT-YEAR CROPS HAVE THEIR OPPORTUNITY TO INCREASE OVERSEAS SALES. AMONG OTHER ITEMS, I FEEL THAT THE MOST IMMEDIATE NEED MIGHT BE IN THE AREA OF MILK AND DAIRY PRODUCTS IN AREAS WHERE LOCAL SUPPLIES ARE CONTAMINATED BY RADIATION. I THINK WE SHOULD EXPLORE PROVIDING NOT ONLY CHEESE, BUTTER AND NON-FAT DRY MILK FROM FEDERAL STOCKPILES, BUT ALSO SEE IF THE SOVIETS MAY BE INTERESTED IN BUYING SOME U. S. DAIRY COWS WHICH WE WILL BE ACQUIRING AS A RESULT OF THE WHOLE-HERD BUYOUT PLAN.

I WILL NOT BELABOR THIS, MR. CHAIRMAN, BUT I THINK THESE ARE AREAS WHICH WE SHOULD BE LOOKING AT VERY CLOSELY.

Senator MATTINGLY. Just generally, I was listening when you referred to the uncertainty of trying to figure out what the facts really are. I think that probably points up one of the major problems with the Soviet Union, and that is the question of whether the Soviet leadership is going to be willing to release the facts we need if we do try to get rid of some of our agricultural surpluses.

Mr. TODOROVICH. Well, yes and no, if we are wise enough. Even the fact that the doctor from, I believe, Los Angeles, bone marrow transplant specialist, was invited to come to Moscow to help them out immediately gives us a whole set of facts which by comparison of what happened elsewhere can give us an indication of the magnitude of the problem and what one can expect is the extent of contamination and all those associated figures.

Senator MATTINGLY. I hope that our interagency task forces will be able to get together. It would help, you know, having the facts from the Soviet Union. In any type of work you do, the more knowledge you have the better.

As Mr. Urbanchuk—is that close enough?

Mr. URBANCHUK. Urbanchuk. That is close enough.

Senator MATTINGLY. Yes, for Government, right? [Laughter.]

I was trying to describe the impact it would have on the grain sales from European Community versus Canada, Australia, and also the United States.

And I think you referred to about $6 billion over a 4-year period of time, that is significant. It is better than minus $6 billion over a 4-year period of time.

Mr. URBANCHUK. Well, particularly in the current environment, the new farm bill, yes, it is.

Senator MATTINGLY. Yes, right.

Now, what would you recommend in that area? You probably spoke about it before I got here—in reference to dairy problems that they would have in milk or also in cheese, butter, and things like that.

Mr. URBANCHUK. Well, primarily in milk. Again, there are conflicting reports that I have heard about whether or not contaminated milk can in fact be processed, then the product stored and just wait out the decontamination period.

But assuming that is the case, primarily in the area of either nonfat dried milk or substitute fat such as increased vegetable oil.

Senator MATTINGLY. Do you think it would be a good idea for us to put up a "For Sale" sign on some of the surplus dairy commodities we have?

Mr. URBANCHUK. That is really not a bad idea. The problem we are going to have again is it comes back in—you know, we have to be very careful in doing that in the sense that we have this ongoing trade dispute with the European Community already, OK?

It is going to be awful hard, I think, to compete with the European Community in terms of dairy products in that particular market. Keep in mind that the European Community is sitting on a tremendous surplus of dairy products.

Senator MATTINGLY. Right, which brings up the 400,000 whole herd buyout provision we have. We can probably give them a real bargain-basement price on live cows, however, if they would like to have them.

Mr. URBANCHUK. Well, if we did it in live cattle, I think you would make U.S. feeder cattle producers, live cattle producers awful happy.

Senator MATTINGLY. Well, I think you are right, but I think it is also obviously a pragmatic answer to real problems.

Mr. URBANCHUK. That is correct, sir. There may be some logistical problems. I am not sure how that would be accomplished, but that may be one way to do it. That is absolutely correct.

Senator MATTINGLY. Great.

Well, I thank you very much, Mr. Chairman. I think it is a worthwhile hearing you are holding today as usual, and I commend you for it.

Senator ABDNOR. Well, thank you. We are just exploring the area to find out information and how it affects this committee, at least on agriculture, and particularly if it is going to affect many, many other areas of our economy and in our country, but we're concerned how some of these questions relate to agriculture.

Could they take a new supply of milk cows or dairy cows from this country, and if they put them out there today or next month, would the danger of contamination still exist in the grass and environment.

Mr. URBANCHUK. Again, I am not an expert on the field of contamination, but I think there are two things to look at with regard to the dairy cow itself. An animal gets basically the same kind of radioactive exposure that a human does. The dose rates I am sure are different, but what may or may not be lethal to the animal itself have little impact on the actual milk produced since that is digested and passed through.

I guess the very brief answer to that is I am not sure. I would suspect that as time went by that danger would be less and less.

Senator MATTINGLY. Yes.

Mr. Chairman, just not to interrupt.

Senator ABDNOR. Go right ahead.

Senator MATTINGLY. I think that is so important about the stored dry milk we have and the stored products which would be noncontaminated and probably would be less——

Mr. URBANCHUK. That is right. That would be noncontaminated. That is right.

Senator MATTINGLY [continuing]. Subject to contamination when they got them in their country.

Mr. URBANCHUK. That is correct.

Senator MATTINGLY. Thank you.

Mr. TODOROVICH. Mr. Chairman, if I may add just on this topic.

Senator ABDNOR. Yes, sir.

Mr. TODOROVICH. Here is where, for example, a great difference will come from depending on whether the process of radioactive emission will come to a rest or will continue for quite a while.

What we are talking about really is milk contaminated with radioactive iodine. Now, radioactive iodine dies out pretty fast if no new radioactive iodine is added. So within about a month or so, one can eat that cheese made from such milk and have no problems.

However, if the slow, continuous emission is persisting from the Chernobyl damaged plant and if the wind directions are in any re-

spect not very good for the Western Europeans, this question of contamination of milk can then continue to exist for quite a while.

In that case, in addition to substitutes for fresh milk which may be in demand there, there is also a question of machinery to process enough of fresh milk there in the Soviet Union or elsewhere, into products which can be stored for longer periods of time until the radiation dies out and the products can be consumed.

So this is what I meant by saying it is important to follow very carefully what is going on there because, depending on the events on the site, the solutions and ideas by which one should guide oneself can be very, very different.

Senator ABDNOR. Do both of you think we have enough of a basis to make that judgment? What is going on from one month to the next?

Mr. TODOROVICH. That is what I said. By just looking at what is coming over the borders—and there is enough of international trade—we can do good detective work and in a certain sense, after a period of a week or so, begin to develop some trends, ideas, and knowledgeability which may then influence even the Soviet Union to begin to open up a little bit more on its past secretiveness and become more cooperative in the sharing of information.

Senator ABDNOR. Mr. Robock, how do we get the kind of information we really need? Is the only way to actually be in the Ukraine and——

Mr. ROBOCK. The best way would be to take measurements in the Ukraine at the site and in the atmosphere at different levels and different locations so that we know what is there, what is coming out right now.

But we have come to the point of sophistication that we have models of the atmosphere now that can calculate where clouds of radioactive gas go.

When I was a graduate student 13 years ago, I spent a summer working at Livermore just at the beginning of this project, which is now to a point where they can, if they know the source and know what the winds are, predict where the cloud of radioactive gas will be and where the fallout will be with some accuracy.

So I think working back from the measurements that were taken in Sweden and the surrounding countries and knowing what the winds were, they can work back and figure out fairly well what the source was, how much radiation was put into the atmosphere at the initial time.

It would be much better to have the data in the Soviet Union to verify this because it is just a model, and we don't have very many cases like this, fortunately, to test the model to see how well it works.

The weather data are exchanged routinely throughout the world and we get those every hour throughout the Soviet Union and the rest of the world. So that is not a problem now.

Senator ABDNOR. What do you think would be Russia's greatest gain in trying to withhold this information?

Mr. ROBOCK. I am not really a political scientist. What I understand is that the domestic market is more important to them than the foreign market. In other words, they have an agreement with the people that they will take care of the people as long as the

people don't ask questions, as long as they trust them, and if the people are still sure that the government is taking care of them and that they are not worried and they keep assuring them everything is OK, then things will be peaceful in the Soviet Union.

And of course it has problems outside the country, but maybe that is their more important concern.

I think also it is just that they don't have a tradition of quickly disseminating information. They think information is important for power, not the use of it but the information itself.

However, I have been participating in the Soviet-American scientific exchange program in meteorology that has been going on for more than 10 years now, and it has been my experience that it has been possible to obtain information from the Soviets.

I have obtained weather data on the temperature in the Northern Hemisphere for the past 100 years that I have used in my research, and they have been happy to provide it, and we have provided them with data that we have collected.

So in that area it has been slow, but it has been possible to obtain information, and we have worked cooperatively with them.

Senator ABDNOR. Well, it would be much easier on the entire world if they would cooperate a little.

Mr. ROBOCK. Well, there is no excuse for not giving out the information at the time of the accident. I don't know whether the system there was capable of—and there were people in command, that they were capable of making decisions and getting them out that fast. But they certainly should have a system.

Senator ABDNOR. I certainly think so.

Mr. TODOROVICH. You see, Mr. Chairman, the atmospheric detail then can be corroborated by investigation of the thyroid radiation of our people who travel, the tourists, and that is another way in which—rather than to rely only on one kind of assumption, one can begin in a scientific way to combine various information and then go backward and develop some insight in what has actually happened at the source.

Senator ABDNOR. Let me return to you, Mr. Urbanchuk.

What kind of U.S. import restrictions would you recommend? Polish pork is an example.

Mr. URBANCHUK. Well, I am not sure I would recommend any import restrictions at this point, to be completely honest with you. I think what we have to do is take a very close look at the levels of contamination and types of contamination and the potential danger to the livestock and dairy industries in those countries that we import products from.

Here I am thinking about processed meat from Scandinavia and Poland and dairy products from Scandinavia primarily. I think we have to look very closely at what the potential danger, what the actual risk is to those particular products before we consider any import restrictions.

I think one of the dangers that we face in this world environment, find ourselves in in terms of the trade situation, is to immediately look at the use of trade restrictions, either pro or con, as a remedy for situations that come up. That may be a temporary response, and it may be a quite appropriate temporary response, but I think we should be very careful in taking a look at that.

Now, we are fortunate in the sense that the countries that we are talking about we do have generally very, very favorable relations with and it should be easy to get that information. I think I would just caution that we be careful about taking a look at what the potential risks really are and not overreact.

Senator ABDNOR. Well, these are some of the questions that are on everyone's mind these days. If you are in the occupation of agriculture, I know the operators are asking themselves what this means and what it means to prices and future prices. The one thing I didn't want to come out of this meeting of course is giving anyone any false thoughts that suddenly prices will go sky high. There is going to be a scarcity of grain and food for the world.

And frankly, what I have heard already, leads me to believe this may be a false assumption as the markets reflected those first couple of days. They were going up to the limits, and then leveling off. It is confusing for the farmer out there trying to decide what the future holds.

Mr. URBANCHUK. I think the farmer finds it probably less confusing than other market observers. Take a look at the situation.

We haven't any observed impact on production. As a result, very few of the fundamentals that underlied that market 2 weeks ago are different than they are right now. Basically, the underlying market fundamentals haven't changed. We are still in a tremendous surplus position in the United States and in the world grain market.

Senator ABDNOR. Yes.

Mr. URBANCHUK. We are making a transition to a new farm program, a new era or environment for agricultural policy in the United States. We are facing trade battles or potential trade battles with competitors both in Europe and in other places.

These things have not really changed the fundamentals of the market. I think what we are looking at, our outlook for the U.S. agricultural sector, is one of slow improvement over the next several years.

What I have tried to depict in my testimony this afternoon is that if we use that slow recovery, both in export and domestic demand, as a baseline any improvement in exports from the United States such as would result under, as I consider, a maximum potential damage to the Soviet crops, let's say 10 percent this year, would be constructive for the market.

I am not saying that will happen, but that is a possibility if in fact we do realize increased exports to the Soviet Union or actually, for the matter, almost any other major producer.

The problem is the world markets don't look good right now, and they are not likely to really improve over the next year or two by themselves.

Senator ABDNOR. I guess I was just thinking in the short run. I recall the soybean market a few years ago, and the Department of Agriculture, guilty or not, predicted that the prices would go continually higher, and on that basis almost every operator of soybeans who had soybeans on hand held onto them when prices were very good, thinking "I am going to get another dollar a hundred here."

And we certainly wouldn't want that sort of thing to happen, and no one knows. That is, I guess, the main thing.

Mr. URBANCHUK. That is absolutely right.

Senator ABDNOR. I have a lot of thoughts in mind, but I think we better move on. We have another panel yet to hear from, and we want to really thank you gentlemen for being with us today and helping us shed some light on this catastrophe in Russia. You have helped us a great deal.

Mr. TODOROVICH. Thank you for inviting us.

Mr. URBANCHUK. Thank you.

Mr. ROBOCK. Thank you, Mr. Chairman.

Senator ABDNOR. Our next panel will be Mr. Dwayne Andreas of Archer Daniels. I saw him come into the room, and we are happy to have him. Mr. J. Frank McCormick, radiation ecologist from the University of Tennessee, and Mr. Donald Frahm, vice president of Sparks Commodities.

Gentlemen, I am sure you know that we are really pleased to have you come on short notice. It is good of you to do it. I am sure you are aware of the uncertainties that exist today as a result of the accident last week. We are just trying to shed a little light on it.

You gentlemen certainly have far more expertise than any of us, and so we do welcome you to the subcommittee.

Mr. Andreas, it was just a couple of weeks ago we had you in front of our committee. I was most impressed by your testimony. I said I was going to have you back again, but I didn't expect to do so quite so soon. But welcome to our panel today, and you may proceed.

**STATEMENT OF DWAYNE ANDREAS, CHAIRMAN AND CHIEF EXECUTIVE OFFICER, ARCHER DANIELS MIDLAND CO., DECATUR, IL**

Mr. ANDREAS. Thank you, Mr. Chairman.

I really am glad that I arrived here in time to hear Mr. Urbanchuk's testimony, because it was very good, and I could say that based on my own studies in research would agree with almost everything he said, and I am pleased that I arrived here in time to hear it.

About all I can do is maybe add some little addendum, in commercial terms to what he anticipated. I was prepared to say that if you had to make an estimate, the first thing we should do is to know that we don't know, at this point the extent of the damage, but we can probably make an estimate with certain parameters, and I was prepared to say that probably between 2 million and 6 million tons would be the extra requirements, due to the damage, as far as we can tell, at this particular time.

However, I think it is significant to take notice of the fact that this extra demand might come for wheat, corn, and as Mr. Urbanchuk said, for vegetable oils. Unfortunately, it is highly unlikely that the U.S. farmers would benefit from any additional demand in wheat.

I want to explain that to you. Wheat is cheaper from France and Argentina and Canada and Australia than it is from the United

States at the present time, and therefore, one would expect that they would buy it where they could make the best buy, and that would not be the United States. There is a little misunderstanding about the long-term wheat agreement that we have with the Soviet Union. I have noticed it said in the press many times that the Russians did not—the Soviets did not live up to their agreement and that is not true. The agreement calls for them to buy a minimum number of tons in the United States at the world market price. Now when the world market price is below U.S. prices, they do not have any obligation whatsoever to buy wheat here. And that is the situation at the present time. Prices elsewhere are lower than they are in the United States.

Senator ABDNOR. Could I interrupt you one second and ask you, what do we call the program, where we subsidize—BICEP?

Mr. ANDREAS. The BICEP Program. Well, as I understand it, there's been a policy adopted in relation to the BICEP Program that it will not be used where it competes with Brazil, because Brazil owes us money, and it will not be used where we are selling to Communist countries.

Now what this means is that we'd have wheat prices out now to other countries considerably cheaper than our price would be to the Soviet Union, who is our oldest and best and biggest customer. Therefore, our sales to other parts of the world tend to depress the world price, but then prices from other countries are at that level and our price to the Soviet Union does not get the benefit of the BICEP Program, and therefore, is higher.

Now that situation might be temporary, because after the new crop prices come in, which will be sometime in August, it may be that our wheat prices will be at the world market level, and we will participate in that business once again.

Now the other where there might be buyers would be fats and oils. The Soviet Union is a big market for fats and oils, and they ordinarily would buy a lot of soybean oil. They will, however, not buy soybean oil in the United States because, here again, our soybean oil price is far above the market, the world market for other products which are substitutable. Palm oil is selling 5 cents a pound cheaper than soybean oil all over the world, and the Soviets have told us, quite frequently, in recent weeks, that they have no interest in soybean oil, because they are buying palm oil very, very much cheaper from Malaysia.

Now you understand, Malaysian palm oil can be cheaper because the Malaysian Government subsidizes the refining of it, very heavily, and because most of the palm oil is raised on plantations that were financed by the World Bank at very, very low interest rates and very, very weak credit terms.

So the competition from that palm oil against the American soybean producer is very keen, and because of that, we cannot expect them to buy soybean oil here.

Now if you go to corn, which is the other category in the category of feed, it is likely that they would come here for corn, because although corn is cheaper at some other places, there is not enough available, and it is highly—it is likely that they will buy part of their corn requirements here. And another factor on the horizon is that the Soviets are in the process of making every effort to bal-

ance their rations like we do in this country by feeding a commensurate amount of protein to their poultry and hogs along with corn. So their soybean meal needs are rising.

Now there we have a chance at getting some of the business. Our competition is not from the EEC, who cannot produce it, and is not from Canada, but it is from Brazil. Now Brazil soybean meal and Argentine soybean meal are heavily subsidized, but there again, they do not have enough to take care of the world market, and after they sell their very cheap, heavily subsidized production, we do have a chance of participating in the business.

So I think, clearly, on commercial terms, we will get some of the corn business, we will get some of the soybean meal business, none of the fats and oil business and almost none of the wheat business.

Senator ABDNOR. Can they expand their soybean markets easily down there or crops?

Mr. ANDREAS. In Brazil?

Senator ABDNOR. Expand in total acres?

Mr. ANDREAS. Yes, they can, and they do have a program financed by the Japanese right now to put another 5 million acres into soybeans, and that, of course, was inspired when we had our embargo on, and people around the world were worried and wanted to buy more and the Japanese stepped into Brazil and financed a very substantial expansion of their soybean production; however, on the other hand, the EEC, where a lot of our competition comes from, cannot produce soybeans.

Now there is another area which we need to be aware of, and that is that the EEC is heavily subsidizing the production of rapeseed. Now we have a sun seed crop, and the Soviets would use a lot of sun oil, but rapeseed is a suitable substitute, and the EEC is selling rapeseed to processors for 30 percent of what they pay the farmers for it. That is a 70-percent subsidy, and that is driving sun oil and soybean oil and cottonseed oil out of the EEC market and is pushing the rapeseed oil into the export market.

So I would say our real problem is not the Soviet Union, who is a big cash customer; our problem is our competitive relationship with the other producers.

Senator ABDNOR. What you are really saying is that even if this was a very serious problem for Russia and their lack of food supply, it really would not have that great an effect on the United States.

Mr. ANDREAS. Yes, I think the effect would be minimal.

Senator ABDNOR. Thank you very much.

Mr. McCormick, I am sure this is one of the more unusual panels you appeared on, where we talk agriculture and radiation and ecology, but there is a direct association here, and I am sorry we kept you waiting, because we certainly want to hear your views on what has taken place this past week.

**STATEMENT OF J. FRANK McCORMICK, PROFESSOR, GRADUATE PROGRAM IN ECOLOGY, AND CENTER OF EXCELLENCE PROFESSOR OF HAZARDOUS WASTE MANAGEMENT AND SCIENCE ALLIANCE, UNIVERSITY OF TENNESSEE**

Mr. McCORMICK. I appreciate the opportunity to be here and to discuss the consequences of the Chernobyl accident on agricultural systems and related natural resources.

What I would like to do is make a few comments about ecological studies of radiation in the environment and tell you what we don't know and we should and then tell you what it is that we know and can provide from ecological science.

As you know, ecology is a scientific study of the relationship of man and other organisms to their environment. In radiation ecology, we focus on the radiation environment. And what we are concerned with is the introduction of radiation into the environment, the transport of radionuclides from plants, soil, animals, to ecological systems, either agricultural or natural.

And then, as the bottom line is so what? Then what are the effects of the radioactivity.

One thing I would like to point our is that in all accidents, nuclear accidents such as the Chernobyl accident or Three Mile Island, smaller scale accidents, there are immediate and direct dramatic, even demonstrable effects that are usually short term and on site. And these are the situations that usually get most of the attention, the attention of the media, the attention of governments. They are so dramatic and demonstrable, and they are the stuff you make movies of, like "The Day After."

But I would argue that the years after are just as important as the days after, and the ecological effects on agriculture or other natural systems may be more long term in nature and they may be more cryptic, and there may be no single day, minute, or hour when you suddenly recognize them. And they are certainly more widespread.

So we are dealing with phenomena that are not so easy to detect and sometimes escape appropriate attention.

We have a few problems in the areas of not really knowing as much as we should today. One of our serious information gaps is, there were a lot of radiation studies initiated by the Atomic Energy Commission back in the late 1950's and early 1960's. And these were designed to be long-term studies. If we look at the effects of radiation in an individual cropland or an individual animal, we get responses in minutes and hours and days. But some of the effects that take place take a long time to really spot.

In about the early 1970's, ERDA, the successor to AEC, decided to pull away all the funding for radiation effects research in this country and to focus it on fossil fuel technologies. And we were right at the point of learning a great deal, and we never have. Today, we know exactly what we knew 10 years ago and not much more. In fact, there is a report of the National Academy of Sciences that came out just a couple years ago, reviewing all Federal research on the effect, biological and health effects of ionizing radiation. The total expenditure of funds looking at environmental effects is $3,000 a year.

Not sufficient, is it?

One of the areas where we haven't kept up as a result of this is the following:

We have a lot of studies looking at point sources of gamma radiation, where you stick a radiation source in an area and then look at the effects, cropland or in the ecosystems around it.

This tells us something about gamma radiation.

On the other hand, there have been very, very few studies of the effects of radiation associated with fallout directly. We were just getting to the point where a few studies were conducted that showed the radiation effects from fallout are qualitatively and quantitatively different from those produced from point gamma sources. And then the research stopped. And we really can't extrapolate from a gamma radiation source, which is kind of like high energy sunlight to a beta radiation source and fallout, kind of like a particle electron, and assume that the effects are at all alike. So it is a big information gap which comes to haunt us at Three Mile Island and now at Chernobyl.

Now even though our models for predicting effects of radiation are not as good as they should be, on the other hand, our understanding of the transport of radioactivity in the environment is pretty good. I would suggest we have three levels of understanding. At one level, where we have very little information, as in this case, we really don't have any source terms or the amount of radioactivity deposited in the Ukraine on a variety of crops or on different natural resources.

We can only speculate. Well, we have models that are no more sophisticated than speculation, but they're fairly useful. For example, we know that for fallout radioactivity in general, it is accepted that the half-life, that is, the amount of time for half of it to disappear, just due to physical weathering, is about 14 days. Just wait 14 days, and whatever you have, half of it is gone.

For different isotypes, this would vary. Iodine is a question in this case. For iodine, it is only 5 days. For different species of plants, it varies, those plants that have broad leaves with hairy surfaces, pubescent surfaces, they hold onto this stuff. Other slick-leaved plants that are angled, for flat out, but toward the Sun, they don't hold it so well. So there are a lot of variables.

Still we have ballpark estimates, how fast it will be lost. Once the radionuclides hit the soil surface, the half-life is about 35 days for fallout, in general. For different isotypes, this varies. Within 35 days, then half of it will go to deeper soils, where it is probably not going to be immediately available for root uptake, because by that time in the Soviet Union, at this time in the Ukraine, the winter wheat crop is not growing so actively. They are going to be getting ready for harvest in about 2 months, I was told.

In addition, only about 25 percent of the radioactivity which remains in the plant reaches the grain itself.

So we have these ballpark ideas about how much goes where, how fast. That is one level of understanding. I suppose it is useful, when we don't know the source terms.

Now at a second, more sophisticated level, there are mathematical models, for example, those developed in the grasslands of the midwestern United States. And these simple equations can predict

the amount of radioactivity per gram of tissue or grain, if given only the amount of radioactivity deposited per area, initially, and the biomass, total yield, production of the crop. And that is not asking too much.

We have estimates of crop production in the Ukraine and elsewhere, and if we could just find out the amount of radioactivity deposited, these very simple formulas would help us a great deal.

Then there are some real nice ecological models. They are dynamic models. And they account for variables such as weather, day by day, the intensity of grazing of livestock, root uptake, resuspension, which is a serious fact. That is, wind blowing the radioactivity back upon the plants again, which really shouldn't be a problem in the Ukraine, because of the environment and variable growth conditions. And these models should be quite accurate.

Now, in all cases, though, the models I have alluded to, for the most part, they have not been validated. They really haven't been tested by real world situations or very good simulations of real world situations.

So on the one hand, even though the Chernobyl accident is a tragic one, it is a heck of an experiment. Here is a chance for scientists throughout the world to validate these models that the United States has certainly pumped millions of dollars into developing, and if we could get good international cooperation, everyone is better off.

The Soviet Union has superb ecologists, radiation ecologists. Perhaps they have equally good models, I don't know.

But I would look at the accident as both an opportunity to validate models, as well as a tragedy.

I think in summary, what I would say is that if we use our ballpark knowledge, it appears that with the 2 months or so left before harvest, the significant amount of radioactivity that was deposited will decay. The radioactivity levels will diminish significantly. So that outside of a zone immediately around the area that you would put into a days-after scenario, perhaps longer term ecological effect may not be so serious. Thank you.

[The prepared statement of Mr. McCormick follows:]

PREPARED STATEMENT OF J. FRANK MCCORMICK

Predicting Ecological Consequences of the Chernobyl Reactor Accident

Dr. J. Frank McCormick, Graduate Program in Ecology and Center of Excellence Professor of Hazardous Waste Management and Science Alliance at The University of Tennessee.

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Ecology is the scientific analysis of relationships of man and other organisms to their environment and to one another. Radiation ecology is a subdivision of the science concerned specifically with the radiation environment; the introduction of radiation into the environment, the transport of radionuclides, accumulation and residence time of radionuclides in the environment and, of course, the effects of ionizing radiations on plants, animals, microorganisms, man and entire ecosystems. Of special concern are agricultural ecosystems.

In all accidents with high level radiation sources there are short term, on site releases which may affect facilities and personnel. Governments and news media tend to focus upon these situations. They are dramatic and demonstrable. They are the stuff of which movies

are made, movies such as "The Day After". However, if containment of radioactivity is insufficient one can expect long term, low level and wide spread ecological effects upon man and the ecosystems upon which he is dependent. Although long term, low level and wide spread effects are less demonstrable and less dramatic, The Years After are no less significant than The Days After. Remedial action for the latter involves primarily human health care and engineering technologies. Understanding of the former must come, in large part, from ecological science. However, our knowledge of long term ecological effects is shamefully inadequate for this task.

Radiation effects are the product, or sum, of damage plus biological recovery. Biological damage can be predicted rather well based upon relatively simple laws of physics. Biological recovery, on the other hand, is more complex and less predictable. For example, in forests receiving a one month exposure to ionizing radiation over twenty years ago, we expected tree growth would be inhibited for a few years and then return to normal. However, it appears that reduced annual growth has persisted over the past two decades. At present, we know very little about these long term ecological effects of ionizing radiations. A series of studies initiated by the Atomic Energy Commission in the early 1960's could provide much needed information if the ban was removed on funding of this critical research. In the early to mid 1970's ERDA, a successor to the AEC, decided to terminate research on the ecological effects of ionizing radiations. Priorities were shifted to research on ecological impacts of fossil fuel technologies. Results of the 1960's experiments could be

obtained at relatively low cost. However, the present total federal expenditure on this critical subject of less than $5,000 per year is insufficient. The fact is, most of what we know today about the environmental-ecological effects of ionizing radiations, we knew over 10 years ago!

One area of ignorance is especially serious. Almost all ecological studies of radiation effects were conducted using point sources of gamma radiation. Very few studies used real or simulated radioactive fallout to investigate radiation effects. Those few which did, demonstrated significant effects of beta radiation which differed qualitatively as well as quantitatively from gamma radiation effects. This is not surprising. Gamma radiation is electro magnetic radiation much like high energy sunlight. Beta radiation is a high speed electron which behaves more like a particle than like high enery sunlight. Unfortunately, funding of radiation ecological research was terminated at a time when significant questions concerning ecological effects of radioactive fallout remained unanswered. Contemporary models of the transport and accumulation of radioactive fallout are quite good, but models of the biological and ecological effects of this fallout are quite speculative. It is difficult, if not impossible, to extrapolate results from point gamma sources to describe or predict effects produced by beta radiation from fallout.

In spite of these constraints, scientists at a few institutions such as Colorado State University, Oak Ridge National Laboratory and

Savannah River Plant continue to advance our understanding of radionuclide transport and long-term recovery of ecosystems. When provided source terms, mathmatical models which mimic ecosystem behavior can describe and predict the transport of radionuclides in the environment. These models also describe and predict radionuclide residence time, accumulation and biological effects on site specific or regional scales. A serious deficiency in the state of knowledge is that very few of the radionuclide transport models have been vaidated; that is, tested under real world or simulated conditions. The tragic accident at Chernobyl presents an opportunity to test existing models and to conduct research which could benefit the rest of the world. The USSR has excellent radiation ecologists who, hopefully, will conduct long term studies of radionuclide fate and effects.

Even without source terms, general knowledge of transport phenomena enables us to predict large scale consequences of the Chernobyl accident. For example, it is generally accepted that radioactive fallout has a 14 day physical half-life on the surface of vegetation. This means, every 14 days the amount of radioactivity is reduced by one half due to physical weathering. Different isotopes vary in this characteristic. Iodine for example has only a 5 day physical half-life. Radioactivity escaping plant surfaces is bound to the soil. The physical half-life for transport from surface soils to deep soils is 35 days in the absence of resuspension. Resuspension of radioactivity on plant surfaces is quite unlikely to occur in the Ukraine. Climate and soils of the Ukraine are among the most

favorable for plant growth in the entire USSR. Good evidence of this is that wheat production per hectare in the Ukraine is consistently twice that for the nation at large. Conditions contributing to resuspension, such as bare sandy soil, low moisture and sparce vegetation should not be widespread in the Ukraine. Therefore, during the two months between the Chernobyl accident and the wheat harvest, most of the radioactivity should leave the vegetation. Much of that which moves from plants to soil should reside in deep soil, unavailable for rapid root uptake and recycling. Of that which does remain in the plant, only 25% reaches the grain.

Accurate predictions require source terms. If one knows characteristics of the initial interception of fallout by the vegetation and basic characteristics of the vegetation itself, quite accurate predictions are possible of microcuries of radioactivity per gram of plant tissue or grain. For example, research on mid-western grasslands has provided equations which are quite accurate in predicting initial concentration of radioactivity per weight of prairie grasses. If one knows the depositon of radioactivity in microcuries per square meter and total biomass produced, one can readily estimate microcuries of radioactivity per gram of the wheat crop. Deposition can be monitored directly and wheat production figures are readily available.

More accurate and sophisticated dynamic transport models have been developed, for example those at Colorado State University. These models describe transport of over 20 different radionuclides through time, following an event such as the Chernobyl accident. Models account for variations in weather, grazing practices, root uptake (recycling) and other factors. These models, which mimic the behavior of natural and agricultural ecosystems, can predict long term consequences of nuclear accidents only if source terms are made available to the international scientific community. Accidents, on the other hand, provide opportunities for much needed validation of existing models, assuming the international scientific community participates in the analysis.

In summary, we have models which predict the fate of radionuclides in the environment. Their accuracy improves directly with the quality of source terms available. On the other hand, we remain shamefully ignorant of the long term ecological effects of ionizing radiations.

I want to thank you for this opportunity to briefly describe the state of knowledge in radiation ecology; to provide examples of the capabilities of ecological science to predict long term consequences of nuclear accidents such as Chernobyl; and to bring to your attention the past decade of stagnation of scientific research in selected critical areas.

Senator ABDNOR. Is it your judgment, for the limited information you have today, that their winter wheat plant could not be contaminated in any way by harvest time—60 days, or whatever?

Mr. MCCORMICK. No; I have to back up on that. First, we don't have any information.

What I am saying is, from our ballpark estimates, based on general theory, in the presence of only general information, we know that the radioactivity levels, whatever they are, are going to diminish rapidly, and so that we should not expect significant levels of radioactivity to persist over wide areas.

That is about as far out on a limb, and my colleagues would ring my neck for going that far probably, in the absence of any real knowledge.

Senator ABDNOR. Well, thank you.

I am going to quickly call on Mr. Frahm. Maybe he had some new thoughts while listening to the conversation and testimony. We are happy you are here with us, Mr. Frahm. Sorry I made you last on the panel, but maybe you can sum it all up in good shape for us, too.

## STATEMENT OF DONALD FRAHM, VICE PRESIDENT, SPARKS COMMODITIES, INC., MEMPHIS, TN

Mr. FRAHM. Thank you very much, Mr. Chairman.

I am pleased to be here, and I think we all agree that this is certainly an intriguing if not in the end a very important incident.

I did prepare some testimony. I would like to review it very briefly, but your staff was provided a copy of it should you care to refer to it.

Senator ABDNOR. Fine.

Mr. FRAHM. I had intended on making comments with respect to both the Chernobyl incident's immediate reaction and its long-term impacts for the markets.

I think with respect to the immediate reaction I would like to add a couple of things to what has been said, prefaced by realizing that, No. 1, the location of this incident, being located in the Soviet Union, was obviously a very sensitive and a very important subject to commodity markets.

Mr. Urbanchuk and several other panel participants so far have indicated the role that the Soviet Union can play in world commodity markets and certainly as a major importer, the world's largest importer of grains. That is certainly well documented.

I think, second, it was a nuclear occurrence. It is one which commodity markets have not had to accommodate or try to evaluate in the past. Had it been a hailstone or a drought or earthquake, even a volcanic eruption such as Mt. St. Helens several years ago. That was a new occurrence for the market, and likewise this certainly was one also.

Given these two specific features, that it was located in the Soviet Union and likewise that it was a nuclear unprecedented incident, I think it is important to realize also that commodity markets have been declining for the past 3 to 4 years, primarily as the result of exploding world—I would say rapidly rising world commodity supplies.

Given that, prices have eroded and even stand today at what would have been called bargain basement levels only a couple of years ago.

Despite these already low levels, however, the market outlook has been for prices to continue to erode to even lower levels as the Food Security Act of 1985 fully comes in to bear with price supports of commodity market programs eroding from under the open market prices.

With that as sort of a basis, even exaggerating this current, if you will, bearishness in the market with the market's realization that in a matter of a very few days the current market supplies, at least of grain—of corn, wheat, and other feed grains—that its supplies would be further supplemented by the Government distribution as part of the 1986 enrollment in commodity programs, there would be a distribution of additional commodities.

So there was immediately ahead of the market an additional negative factor which was important in I believe that the market position come—or as of a week ago.

So there was certainly reasons for the commercial user and the speculative market participant to have a short position in the market a week ago and, certainly with that, a price rise would be costly.

The immediate reaction of the Chernobyl incident, because of these features mentioned, was certainly one of uncertainty and rising prices.

Short covering and the promise of economic reward to those who were long certainly fed the buying interest in the market. The selling interest in the face of this uncertainty in the immediate market direction was likewise rationally restrained, though I might say certainly not absent at all. Commodity markets generally moved in lock step with the latest news bulletin released by the media, and everyone attempted to become a nuclear expert.

With the impact of radioactive pollutants from the first reactor still uncertain, the media reports on midmorning Wednesday that a second nuclear reactor was not involved heightened the market uncertainty. It was this report that peaked the market concern during the previous week and likewise the failure for it to be confirmed that turned the tide, if you will, of the market from one of escalating seriousness to one toward moderation.

Looking back at the events of the first week——

Senator ABDNOR. What has been the result? Like today what happened to the market?

Mr. FRAHM. I had not picked up the closes when I came in. Prior to coming in, they were modestly to minorly higher, with 1 to 2 cents on grains and increases on——

Senator ABDNOR. Not necessarily because of anything?

Mr. FRAHM. Possibly Mr. Andreas has checked since I have.

Senator ABDNOR. No; let's go right ahead. I was just curious.

Mr. FRAHM. I think looking back at the events of the first week, one general observation that I would like to make is that despite the tremendous uncertainty that was generated by this particular event, cash and futures markets for agricultural commodities were able to accommodate with only very limited exceptions any buying or selling activity someone desired to take.

Futures volumes exploded, ballooning to—not exploded—futures volumes ballooned to two and three times their recent levels, and yet the exchanges continued in an orderly operation. I personally think that this performance should be encouraging not only to the participants in these markets but also to those individuals and agencies responsible for regulating them.

A few brief comments on the longer term impact.

In addressing the potential long-term impact of the Chernobyl incident on the U.S. agricultural commodity situation, we must acknowledge at the outset, as has been pointed out here numerous times today, that information regarding the details of the incident are extremely sketchy. The area affected by the nuclear pollution and the magnitude of the radioactive contamination is unknown.

I have been personally advised that the radioactive pollution from this incident at a maximum will be no greater than that created by numerous individual atmospheric nuclear tests conducted during the 1960's by many countries, including the United States.

I have had this opinion negated by numerous other sources and would be less than honest with both you and myself if I proposed to know with any confidence where the facts lie.

It is our suspicion, however, that the adverse production impacts of this incident will be negligible.

There are, however, well-known facts regarding supplies that can be used to supplement those production losses that might occur both during the upcoming growing season and subsequent years.

As has been indicated earlier, world wheat and coarse grain surpluses are currently unprecedentedly large. I had mentioned early in my testimony that United States and world wheat carryover stocks will approach some 170 million tons in advance of this year's harvest, or some 90 to 95 percent of the Soviet's total grain production—total average grain production over recent years.

And I think it is important to point out, even with 47 to 48 million acres held out of production in 1986 within the United States, this year's harvests are likely to add another 25 to 30 million tons to this surplus.

These existing world and U.S. surplus stocks are certainly more than sufficient to offset whatever production declines might result from the Chernobyl incident during the coming year, conditioned by any sort of information which we can today gather and even if U.S. acreage held out of production could be brought back into production in future years.

Therefore, even with critical facts of the Chernobyl incident unknown at this time, we believe that it does not significantly alter the outlook for U.S. commodity markets. Enormous surpluses that currently exist will serve as a buffering influence against the prevailing uncertainty, and the authority given to the Department of Agriculture within the Food Security Act of 1985 provides them with more flexibility to manage these surpluses as conditions warrant than has historically been the case.

Continual pursuit of additional details regarding the Chernobyl incident and the evaluation of their impact on the food chain is mandatory. It is, however, most likely that it will go down in history as an insignificant event for U.S. commodity markets.

Thank you, Mr. Chairman.

[The prepared statement of Mr. Frahm follows:]

## Prepared Statement of Donald Frahm

Many specifics of the Chernobyl incident along with the exact timing of its occurrence were important factors in the market's reaction to it during the past week, immediately after its occurrence, and will continue to be critical factors during coming weeks, months and possibly years. In my remarks I would like to divide my comments into two broad areas, namely the immediate reaction and secondly the lasting or longer term impacts.

As background to these comments regarding the market or price impact of this incident, several general features need to be noted. First of all, its particular location. Chernobyl is in the Soviet Union. And, not only is Chernobyl within the important Ukranian agricultural area, it is located within several hundred miles of Eastern and Western European neighbors. The Soviet's agricultural situation in particular has for many years been a very critical market making factor for world agricultural markets because of its absolute size, the variability of their annual production, and their general position as the largest single importer of grain in the world.

Secondly, this was a nuclear occurrence. An emotional incident and one for which no precedent existed. This lack of experience with an admittedly frightening incident presented market participants with the need to analyze an event for which they had no criteria. Had it been an earthquake, a hailstorm, a disease or insect infestation, or an unexpected crop freeze affecting a potential commodity supply; past experience and reasoning would have allowed quick evaluation. No so, however, for the melt down of a nuclear reactor. In addition to these two features of the Chernobyl incident that made it a potentially significant event, but not one without precedent, the markets general disposition also made the timing of its occurrence important. Excess world commodity production over the last five or six years has resulted in the accumulation of unprecedentedly large surplus stocks. World wheat and coarse grain stocks from previous harvests are currently record large in absolute terms approaching 300 million metric tons or something like 22-23 percent of annual usage. Within the US in particular, ending wheat and coarse grain stocks remaining from last summer's harvests will total 170 million tons in addition of those quantities to be harvested in 1986. These carry over stocks represent some 85 percent of annual US domestic requirements and some 60 percent of record large total usage that included large export volume several years ago (1979-80). Given this surplus environment, US commodity prices have been trending lower for the past three years reaching levels which would have been thought bargain basement low as recently as a year ago.

Despite these already low levels, however, the market outlook for price direction had been for even lower levels in coming months as the US Food Security Act of 1985 comes into full force lowering government programs market price supports. With this general situation prevailing, commodity

users both within the US and around the world were generally of the opinion that minimal forward purchases should be carried. Surpluses should preclude rapid price advances and the prospects for even lower prices would allow them to cover their upcoming needs at a reduced cost.

Exaggerating this minimal coverage strategy even further at the beginning of last week (April 28, 1986) was the knowledge that beginning in only 2 or 3 days (April 30, 1986) market supplies would be supplemented by the scheduled release of commodities from US government program holdings associated with participation in 1987 crop feed grain and wheat programs. The proximity of this event was even further reason to expect near term price declines encouraging short positions in the market by both the user and the commodity speculator. Both intermediate and immediate factors therefore existed that justified market positions that put both the commercial user and the speculative market participant in a short position for which a price rise would be costly.

Immediate Reaction: Given the nature of the Chernobyl incident and the particular market disposition at its occurrence, the market's immediate reaction early last week was predictable. An unprecedented event had occurred in an important agricultural producing area of the world. The magnitude of its impact on both short-term and long-term agricultural commodity supply and demand fundamentals was uncertain, and maybe incalculable. And, the disposition of both commercial and speculative market participants was one which would yield financial loss in a rising market. Short covering and the promise of economic reward to those who were long something whose price was rising fed buying interest. Selling interest in the face of the uncertainty prevailing and the immediate price

direction was rationally restrained, though certainly not absent. Commodity markets generally moved in lock step with the latest news bulletin released by the media and everyone attempted to become a nuclear expert.

With the impact of radioactive polutant from the first reactor still uncertain, media reports mid-morning Wednesday that a second reactor was now involved in the incident hightened the uncertainty. It was the report that peaked the market concern during the week and failure to confirm this expansion of the incident later the same day that changed the situation from one of escalating seriousness toward moderation. Grains, oilseeds, cattle, hogs, sugar and even cotton had all reacted to the uncertainty created by the Chernobyl incident. By the weeks close, some retreat had been seen in early week price gains but likewise all remained above those which existed prior to the incident's occurrence.

Looking back at the events of the week one general observation can be made. Despite the tremendous uncertainty generated by the particular nature of the Chernobyl incident, cash and futures markets for agricultural commodities were able to accommodate with only limited exceptions any buying or selling activity desired. Futures volumes for example ballooned to two and three time their recent levels with exchanges continuing orderly operation. This performance should be encouraging to not only the participants in these markets but also those individuals and agencies responsible for their operation.

Long-Term Impact: In addressing the potential longer term impact of the Chernobyl incident on the US agricultural commodity situation, we must acknowledge at the outset that information regarding the details of the incident are still very sketchy. The area affected by the nuclear polution and the magnitude of radioactive contamination is unknown. I have been personally advised that the radioactive polution from this incident can, at a maximum, be no greater than that created by numerous individual atmospheric nuclear tests conducted during the 1960's by many countries, including the United States. I have also had this opinion negated by other sources and would be less than honest with both you and myself if I proposed to know with confidence where the facts lie. It is my suspicion, however, that adverse production impacts of this incident will be negligible.

There are, however, well know facts regarding supplies that can be used to supplement those production losses that do occur both during the upcoming growing season and during subsequent years. As I indicated earlier, world wheat and coarse grain surpluses are currently at unprecedentedly large levels. You will recall that I mentioned US wheat and coarse grain carryover stocks alone will approach some 170 million tons in advance of this year's harvests or some 90-95 percent of the Soviets total average grain production in the last few years. And, even with 47-53 million acres held out of production, 1986 US harvests are likely to add another 25 to 30 million tons to this surplus. These existing world and US surplus stocks are certainly more than sufficient to offset whatever production declines might result from the Chernobyl incident during the coming year. And, the US acreage held out of production could readily be brought back into cultivation in future years should at be warranted.

Therefore, even with critical facts about the Chernobyl incident unknown at this time, we do not believe that it significantly alters the basic outlook for the US commodity markets. Enormous surpluses that currently exist will serve as a buffering influence against the prevailing uncertainty. And the authority given to the Department of Agriculture within the Food Security Act of 1985 provides them with more flexibility to manage these supplies as conditions warrant than has historically been the case. Continual pursuit of additional details relating to the Chernobyl incident and the evaluation of their impact on the food chain is mandatory. It is, however, most likely to go down in history as an insignificant event for US commodity markets.

Senator ABDNOR. Well, thank you, Mr. Frahm.

This has indeed been a very interesting hearing today, and I think maybe it has changed some of us, who don't profess to be any kind of expert, to reassess a lot of things, including what the results of this catastrophe over in Russia might be.

Is it serious enough that you think, Mr. McCormick, that the Soviets might place some kind of a quarantine on any of their crops or livestock in the immediate period?

Mr. MCCORMICK. The only kind of quarantine that I have heard discussed is the type proposed also by the French, and that is to set up quarantines of different and varying intensity in zones at varying distances away from the site of the accident, so that, for example, you would quarantine—the quarantine would just be very severe closer in and milder farther away.

This is the only kind of quarantine I have heard discussed.

Senator ABDNOR. Do you know enough about it, with the information you have, to suggest how far out the danger area might be, or the seriousness of this problem over in the Ukraine? Is it a vast area? Is it just going to be the immediate area around the plant?

Mr. MCCORMICK. No. Just like everyone else, I think I get my information through the press.

Senator ABDNOR. Well, that is where a lot of us get it.

Mr. MCCORMICK. And, you know, that would suggest you are talking about a very small area, 20 miles in diameter, 10 miles in radius, something like that.

Senator ABDNOR. Well, then, Mr. Andreas, you would have to say the same thing actually about how future prices in America and in the agricultural arena are going to be affected more by our farm programs that by what the weather might do in the immediate future or even in Europe?

That could have quite an effect if you add this to serious weather. But here in this country with the new farm program going into effect, maybe making us more competitive, the impact might be greater than what we are talking about here today.

Is that a fair statement?

Mr. ANDREAS. Yes, I think so.

I believe that we have to look forward to the time when maybe this is the last unilateral farm bill we will ever see because the entire agricultural business has become so global that it will be necessary for us to coordinate, I think, with the EEC and with Brazil and others more and more every year in order to keep from inventing programs that hurt each other, and I believe that the EEC and the Brazilians and the others are willing to coordinate. But it is just that it has to become very evident, and it is becoming.

Senator ABDNOR. Well, making ourselves more competitive with this new program might help.

Mr. ANDREAS. I think our farm program, the way it is structured right now, has great possibilities to make the United States more competitive next year all across the board, and that in fact will probably be the only thing that will lead to some coordination and some negotiation.

Senator ABDNOR. How do you feel about that, Mr. Frahm?

Mr. FRAHM. I would agree wholeheartedly. I think that certainly we are moving in a far superior direction than we were recently,

and I would agree that we simply have to, that the world is—I believe it is your term in Washington. There are many, many linkages today, and they are becoming even closer as times pass, and it is a small world as far as policy goes, whether it be agricultural policy or any sort of policy from the Government level.

Senator ABDNOR. So it is a whole new ball game from 20 years ago.

I recall it was suggested by someone in this country that through the World Bank or IMF a loan should be made to Brazil, I think, so they could lower their export tax. Is that——

Mr. ANDREAS. That is true, and to Argentina some $400 million to develop more crops.

Senator ABDNOR. Not only develop, but get a little bit of an advantage if an export tax is levied. But trying to do away with that makes it even more difficult to get into the trade arena with them.

Mr. ANDREAS. That is right.

Senator ABDNOR. It almost brings us back to—like some suggest—producing solely for our domestic needs. I don't think that is any answer either.

Mr. ANDREAS. Well, I am afraid that would shrink us down to where it would be a hardship on everybody.

Senator ABDNOR. We would see rural America disappear.

Well, gentlemen, I thank you every much for being here. No one is ready to go out on a limb and say what is going to happen, but at least in my mind, it certainly sheds some light on what, I think, the future might be for commodity prices in this country as a result of what occurred in Russia.

I think this has been on a lot of people's minds. Let's hope that in the months ahead there will be more light shed on this subject. It would be awfully nice if Russia would let our scientists, and researchers, enter their country to determine for themself the causes and effect of Chernobyl because nuclear power is certainly here and it could affect any part of the world and we might be able to prepare.

Let's hope the research you suggested 10 years ago continues, Mr. McCormick; we need to think and rethink that one through. I believe that it is important for us to carry on with research.

So I thank you very, very much for coming. Again, I know you had to do so on short notice, and I look forward to having you back again, because I think your experiences do help.

Mr. MCCORMICK. Thank you very much.

Mr. ANDREAS. Thank you very much, Mr. Chairman.

Mr. FRAHM. Thank you, Mr. Chairman.

Senator ABDNOR. With that, the subcommittee will stand in adjournment.

[Whereupon, at 3:45 p.m., the subcommittee adjourned, subject to the call of the Chair.]

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